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AN APPRAISAL OF SELECTED FINDINGS OF QUALITY DEFICIENCY REPORTS--ETC(U)
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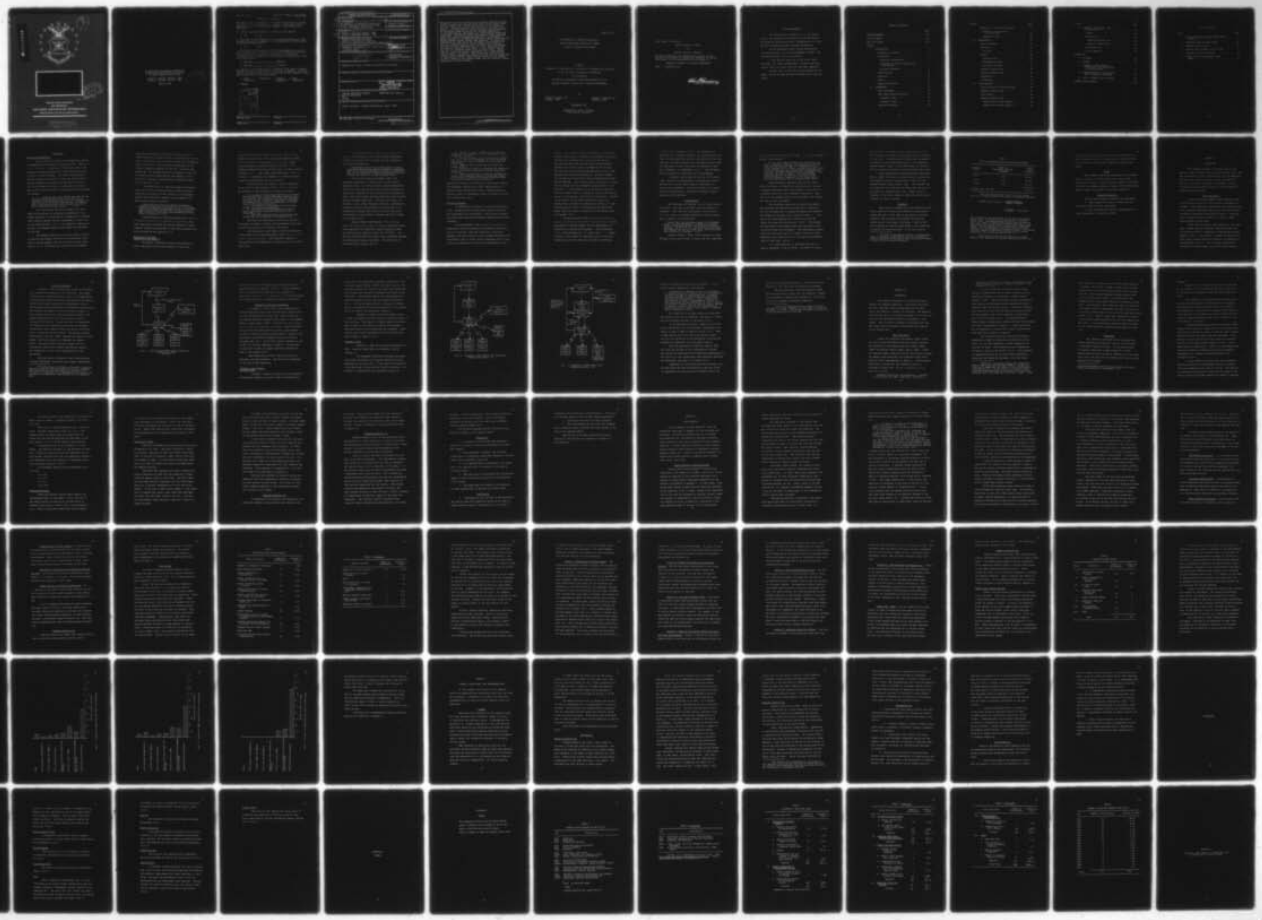

UNITED STATES AIR FORCE

AIR UNIVERSITY

AIR FORCE INSTITUTE OF TECHNOLOGY

Wright-Patterson Air Force Base, Ohio

AN APPRAISAL OF SELECTED FINDINGS OF QUALITY DEFICIENCY REPORTS FOR ITEMS IN THE 59 FEDERAL STOCK GROUP

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SLSR 33-76B

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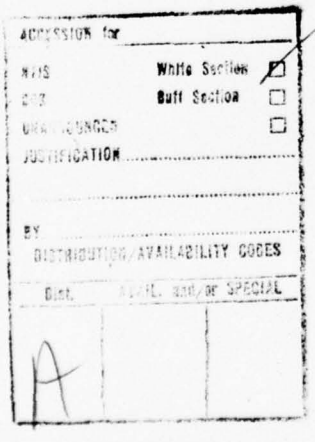

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The objective of this thesis was to identify specific failure causes of electrical and electronic parts and to group these failure causes into distinct groups having like causes of failure. These groups were then analyzed to identify areas where a high proportion of quality failures were originating. To accomplish these objectives an in-depth examination of the USAF Materiel Deficiency and Investigating System was undertaken. The Quality Deficiency Reports (QDRs) submitted under this system on common-use electrical and electronic parts purchased by the Defense Electronic Supply Center and the Defense General Supply Center were examined. The study was restricted to items within the 59 Federal Stock Group which were the responsibility of the Engineering and Technical Services Division, Headquarters, Air Force Logistics Command. Two research questions were asked. First, "What causes of failures in electrical parts could be identified?" Second, "was any particular area(s) responsible for a large proportion of quality failures?" The conclusions drawn from the research effort support the proposition that failure causes can be identified, and that these failure causes can be grouped in such a manner as to identify areas that are causing a large proportion of part failures.

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AN APPRAISAL OF SELECTED FINDINGS OF QUALITY DEFICIENCY REPORTS FOR ITEMS IN THE 59 FEDERAL STOCK GROUP

A Thesis

Presented to the Faculty of the School of Systems and Logistics

of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the Requirements for the

Degree of Master of Science in Logistics Management

By

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has been accepted by the undersigned on behalf of the faculty of the School of Systems and Logistics in partial fulfillment of the requirements for the degree of

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CHAPTER I

INTRODUCTION

Statement of Problem

Air Force maintenance shops often find that the electrical and electronic parts they are using are defective. These failures may have been discovered when installed equipment failed or when replacement parts received from supply were tested and found to be unserviceable. Regardless of how the failures were discovered, they can cause degraded performance of electronic equipment and decreased mission effectiveness.

Defects which render a part unserviceable may have occurred any time during manufacture, shipment, storage, delivery of the part to maintenance, or during the repair process. One important factor in preventing defects from occurring is to identify exactly where actions were taken that resulted in the part becoming unserviceable. The manufacturer's nonconformance with specifications or quality control procedures could be at fault; however, there may be other factors which contribute significantly to these quality deficiencies. The problem is to discover exactly where discrepant actions occurred and to what extent they contribute to quality deficiencies.

Background

Historical Perspective

The Air Force philosophy which emphasizes quality in components and equipment is relatively new. The *Reliability Guidebook* (5) provides a historical look at the problem of product reliability in both the military service and civilian industry. The author contended that lessons learned in World War II were the direct cause of current emphasis on equipment and systems reliability. The United States felt that its technology was superior during the war but a variety of deficiencies were revealed. For example:

> . . . sixty per cent of aircraft destined for the Far East proved unserviceable; fifty per cent of electronic devices failed while still in storage, the service life of electronic devices used in bombers were a mere twenty hours, while seventy per cent of naval electronic devices failed . . . [5:9].

The late Forties saw the development and use of sampling techniques for acceptance inspections of purchased materiels, the publication of Department of Defense (DOD) sampling tables, and the indorsement of their use by the armed services (4:3) in an attempt to improve the quality of purchased materiels and reduce the magnitude of failures.

The defense agencies, by the very nature of their voluminous procurement activities, have had great influence on the development and use of quality control techniques (4:4). The growth of quality control programs

parallels the changing attitudes of defense agencies toward the role of quality control in procurement activities. During World War II and the Korean War the emphasis was on the "use" of quality control techniques by the various inspection agencies of the DOD. Following the Korean War, the emphasis shifted to promotion of the use of quality control techniques by the supplier, accompanied by "assurance" methods used by inspection agencies of the DOD (4:4).

Since World War II, the environment has changed from one of fairly simple products to complex systems requiring new controls of men, materiel, and equipment. Systems have become more complex and the emphasis has been placed on quality products.

> Attention was focused on system integration, component compatibility, producibility, value engineering and systems maintainability--all to be undertaken in the frame of reference of standard parts, mass production techniques, and extremely high standards of reliability [1:5].

The publication of Military Standard 105, *Sampling Procedures and Tables for Inspection by Attributes*, and other applicable standards has forced suppliers to adopt adequate inspection procedures to keep their products from being rejected by DOD agencies (1:5).

Pertinent Directives, Regulations, and Manuals

The federal government invests large amounts of public resources with private industry to obtain the

supplies and services needed for military use. The DOD budget for Fiscal Year 1975 included approximately twenty billion dollars for procurement out of a total budget of approximately ninety-three billion dollars (6:4). Taxpayers demand that DOD contract wisely to obtain quality products at ". . . the lowest practicable cost [6:4]." In order to accomplish this mandate, an effective quality assurance program should be in existence.

The DOD policy with regard to quality assurance is set forth in DOD Directive 4155.1, *Quality Assurance*. The purpose of this directive is stated as follows:

> This directive establishes Department of Defense quality assurance policies designed to assure that all materiel, data, supplies and services developed, procured, stored, operated, maintained, overhauled, or disposed of by or for the Department of Defense meet the following objectives:
>
> A. that materiel, data supplies and services conform to specific requirements,
>
> B. that specified requirements for materiel, data, supplies and services are practical and enforceable; and
>
> C. that user dissatisfaction and mission ineffectiveness are prevented or eliminated [28:1].

The directive specifically states that the policies apply to supply, storage, and maintenance activities as well as procuring or producing activities.

Air Force policy with regard to quality assurance is set forth in Air Force Regulation (AFR) 74-1, *Air Force Quality Assurance Program.* The regulation expands on the DOD policy and emphasizes its application to Air Force activities.

Air Force Regulation 66-30, *Product Improvement Program*, establishes the Air Force Product Improvement Program and explains how to report and use information on quality deficiencies.

> Improvement projects are established to correct identified deficiencies affecting mission accomplishment and are given precedence according to the magnitude of the reduction in safety, maintainability, and reliability caused by the deficiencies [24:1].

The Air Force Logistics Command (AFLC) has extensive procedures to retrieve and utilize quality deficiency data. Air Force Logistics Command Regulation (AFLCR) 74-1 provides guidance and uniform procedures to assure data generated by using activities is effectively used. AFLC continuously analyzes deficiency data provided through customer complaints. Although this source of feedback is not always completely accurate, inferences of significant quality deficiencies can be derived (14:1). Communication between AFLC and the customers during the investigation of the problem, enhances the effectiveness of this data (14:1).

Chapter three of AFLC Manual 74-12, *Material Management and Quality Assurance Program*, specifies procedures applicable to deficiency reports submitted under the provisions of Technical Order (TO) 00-35D-54. Procedures are described which assure that interested managers are appraised of quality problems. The objectives of deficiency data analysis are to:

a. Establish quality trends for all materiel already in the inventory and for overhauled or new procurement materiel.

b. Provide managers at all levels with information to be used as a management tool for evaluating the quality of items or systems for which they are responsible.

c. Identify quality problems by product and product source.

d. Facilitate review of responses and corrective action initiated by responsible quality assurance activities.

e. Insure that action is taken to preclude the issue of all suspected defective items from supply and to repair or replace any known defective items in stock or already in use [16:3-1,2].

Appropriate records are maintained of deficiency reports and subsequent replies that permit identification of quality trends and deficient items. These records are used as a basis for management action to prevent and correct deficiencies (25:2).

Military Standards

To effectively determine if quality deficiencies exist, standards must be established against which current performance can be measured. Much of this information comes from reliability programs required by military standards.

Military Standard 756A, *Reliability Prediction*, establishes uniform procedures for predicting the reliability of aircraft, missiles, satellites, electronic equipment and subdivisions of these systems throughout the development phase to reveal design weaknesses and to form a basis for determining reliability requirements of the

product. The procedure used is referred to as the part-failure method which is "based on the premise that product failures are a reflection of part failures [30:11]." Military Standard 756A requires that the manufacturer determine the failure rate or probability of survival for each part using existing manufacturer's data or data specified by the procuring activity, and then compute the reliability of the product using predetermined mathematical methods. This "drawing board" reliability is used to help ensure that the requested specifications can be achieved. In the standard, it is pointed out that the quality of parts used in a system is a major contributing factor to the over-all reliability of the system. Further, if the quality of the parts used in the repair of a system after it enters the operational inventory is less than the quality used in the design and manufacturing phase, then the overall reliability of the system could be affected (30:1).

Military Standard 785A, *Reliability Program for Systems and Equipment Development and Production*, is also applicable to DOD procurement for the development and production of systems and equipment. Under paragraph 5.2.3, "Parts Reliability," it states that ". . . preferred parts lists should be developed with priority consideration given the used parts included in preferred

military parts documents [31:6]." The standard also specifies that, whenever possible, military specification parts having established failure rate levels will be used. "The best available estimate of a reliability index under the applicable stress levels shall be assigned to each part, component, or subassembly [31:6]." The estimates provide a means for evaluating parts' performance.

In summary, DOD directives and Air Force regulations require the establishment of appropriate control systems with quality judged against requirements in the Military Standards. The entire effort is to assure quality is maintained in materials purchased or manufactured by DOD agencies.

Justification

The Department of Defense, like all other facets of society, continues to be faced with the problem of inflation. This fact was highlighted in an article in *Air Force Magazine* by former Secretary of the Air Force, John L. McLucas. He stated that:

> Since 1968, the purchasing power of the defense budget has declined some 40%, although the funding level in then-year dollars has remained relatively constant. In FY'75 alone, inflation since the budget was prepared has already taken about $6 billion more than originally programmed [9:53].

General George S. Brown, United States Air Force, Chairman of the Joint Chiefs of Staff, has also expressed

his concern about inflationary trends. In a recent address, General Brown stated:

> We feel the squeeze brought on by inflation, the cost of manpower, supplies, and equipment on the one side and the pressing need for modernization and force readiness on the other. Weapons costs are rising at the current rate of 15 percent and discounted for inflation, defense expenditures have decreased 18 percent over the past 10 years. This year defense expenditures will be less than 6 percent of the nation's productive capacity, or the lowest point since the post-World War II demobilization [26:5].

These statements emphasize that the Air Force should find ways to effectively and efficiently continue to operate and meet mission requirements in this era of increasing costs and tight budgetary constraints. Each dollar of the defense budget should be made to go further now than it ever did before.

The increasing complexity of modern-day weapons and equipment has magnified the problems of inflation and the increased cost of supporting operational systems. One example of the high cost involved is that ". . . the yearly Air Force expenditure to maintain 10,000 UHF radios is sixteen million dollars [7:15]." The control of maintenance costs becomes even more significant when life-cycle costs are considered. "The maintenance support costs over the life cycle of a typical item of military equipment often range from 10 to 100 times the procurement costs of that item [2:iii]."

It is very difficult to determine the cost of quality assurance in the Air Force. An effort to arrive

at this cost is presently being undertaken by the Air Force Logistics Command[1] but estimates are not available at this time. The magnitude of these costs is apparent by examining cost figures applicable to the Technical Support Branch (LOIET) of the Engineering and Technical Services Division located at Wright-Patterson AFB, Ohio.

LOIET receives and processes Quality Deficiency Reports (QDR) from users of items centrally procured by the Defensé Electronic Supply Center (DESC) and the Defense General Supply Center (DGSC). The average cost for operating this facility for three years was $42,476 per year for manpower alone (13). Table 1 gives a breakout of the total number of QDRs received and costs incurred in their analysis.

Objective

There were two objectives in this research study. First, specific failures were traced to actions which caused the part to fail when it was placed in service. Secondly, failures were consolidated into distinct groups having like causes of failures. These groups were analyzed to identify areas where a high proportion of quality failures originate. If an area could be

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[1]The Quality Engineering Branch at Headquarters AFLC is currently consolidating cost data incurred in quality assurance activities at the Air Logistics Centers of the Air Force Logistics Command.

TABLE 1

COST OF PROCESSING QUALITY DEFICIENCY REPORTS

Calendar Year	Number of Deficiency Reports Processed	Annual Cost (dollars)*
1974	850	34,425
1975	1,003	40,621
1976**	1,318	53,375
Average Cost Per Year		42,475

*The cost was estimated by dividing the annual pay roll of HQAFLC/LOIET by the number of personnel assigned.

$$\text{Average Annual Payroll} = \frac{\text{Annual Payroll}}{\text{Number of People}}$$

$$= \frac{\$242,913}{13} = \$18,685.61$$

This figure was then divided by 52 to obtain the weekly payroll cost. The weekly cost divided by 40 gives an hourly rate. The manhours expended per year divided by the total number of deficiency reports processed in that year gives the average hours for processing a deficiency report. Multiplication by the hourly rate yields the average cost of processing a deficiency report. Multiplying the total number of deficiency reports by the average processing cost yields the annual cost (13).

**The data for 1976 was projected cost figures based on data reported for January through June 1976 (13).

highlighted which was responsible for a large number of part failures, action to increase quality control efforts in that area could reduce the number of failures that occur.

Scope

This research effort was restricted to an investigation of parts in the 59 Federal Stock Group (FSG). It was further limited to those classes of parts in the 59 FSG for which the Defense Electronic Supply Center and Defense General Supply Center were the procuring agencies.

Research Questions

The following research questions were addressed:

1. What causes of failures in electrical and electronic parts could be identified?

2. Was any particular area(s) responsible for a large porportion of quality failures?

CHAPTER II

BACKGROUND

This chapter provides an in-depth look at the source of data selected for use in the research study. The data instrument is first identified and its use described. The deficiency reporting system is then reviewed and routing of the data instrument is discussed. Finally, an exception to the normal routing of the instrument is identified and described.

Data Instrument

Quality Deficiency Reports (QDR) submitted under the provisions of AFR 74-6 were the data instruments of interest. These QDRs were submitted by user organizations in an attempt to determine why quality failures occurred in specific electrical and electronic parts. Investigation of these failures resulted in a failure caused being assigned in each case.

There are two types of QDRs submitted. The Category I report concerns emergency conditions which have the clear potential of presenting an unacceptable safety hazard (27:2-1). The Category II report is submitted on more routine matters which are primarily attributable to nonconformance (27:2-1) Each of these categories is described in greater detail in the following sections.

Deficiency Reporting System

The Quality Deficiency Reporting System was established as a result of AFR 66-30 which ". . . establishes the *Product Improvement Program* and tells how to report and use information on material deficiencies [24:1]." TO 00-35D-54, *The Material Deficiency Reporting and Investigation System*, describes the internal Air Force system for reporting/recording deficiencies, implements AFR 66-30, and:

> . . . establish(es) a system that will feed back deficiency data to activities responsible for development, procurement, and other logistics management functions so that action can be initiated to correct and prevent materiel, design, and quality deficiencies.
>
> . . . . . .
>
> The procedures of this technical order apply to all USAF agencies, including organic depot level maintenance facilities, civil contractors and Air Force test and evaluation teams or forces [27:1-1].

As noted previously, Quality Deficiency Reports are submitted by using activities in either a Category I or Category II report depending upon the urgency of the situation.

Category I QDR

A Category I QDR is a report of:

> An emergency condition on all types of equipment which presents, or has the clear potential to present, and unacceptable safety, operational, or maintenance hazard [27:1-1].

Category I reports are submitted by electrical transmission on DD From 173, Joint Message Form (27:21).

Submission of a Category I report generates an investigative project which demands the highest priority (27:2-1). Upon receipt, each Category I report is assigned a Material Improvement Project (MIP) number (17:10-1). MIPs are established by AFLCR 66-15, *Product Performance*, as a means of closely supervising investigative actions of suspected deficiencies on operational systems, equipment, and munitions (17:10-1). Essentially, this category of reports receives priority attention and a published, systematic evaluation of the deficiency. It is felt that additional expenditure of resources to rectify the reported problem is justified (17:10-1).

Category II QDR

A Category II report is submitted on deficiencies that do not constitute a safety hazard but could have an adverse effect on operational efficiency, reduce mission support ability, or reduce the operational life or service utilization of equipment (27:1-2). Deficiencies reportable under Category II could lead to increased costs of supporting operational equipment if not corrected. Category II reports are submitted by AUTODIN[1] using Form 386 format (Appendix C) (27:2-1).

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[1]AUTODIN--Automatic Digital Network (27:k1)

Routing Procedures

Category I and II reports are routed in accordance with instructions specified in TO 00-35D-54. The report is sent by the originating point (user) to the appropriate screening point after review and concurrence of the quality control staff and/or the Chief of Maintenance (27:2-2). The screening point determines the responsible action point and forwards the report to the action point (Figure 1). The screening point also redirects misrouted QDRs to the proper screening point and the originating point is informed of the action. The action point is responsible for resolution of a deficiency including the necessary collaboration with support points that assist the action point in resolving the deficiency. The Defense Contract Administration Service (DCAS), engineering support offices, supply, and other agencies as necessary are support points. The action point can also request that the originating organization forward the Materiel Exhibit[2] for examination to aid in the investigation of the deficiency.

Once the cause of Category I and II deficiencies has been determined, the action point agency communicates

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[2]The originator of the QDR is required to hold the defective item as a Material Exhibit for thirty calendar days after the date the deficiency was reported (27:7). The activity responsible for investigation will provide the orginator with dispostion instructions for the defective part.

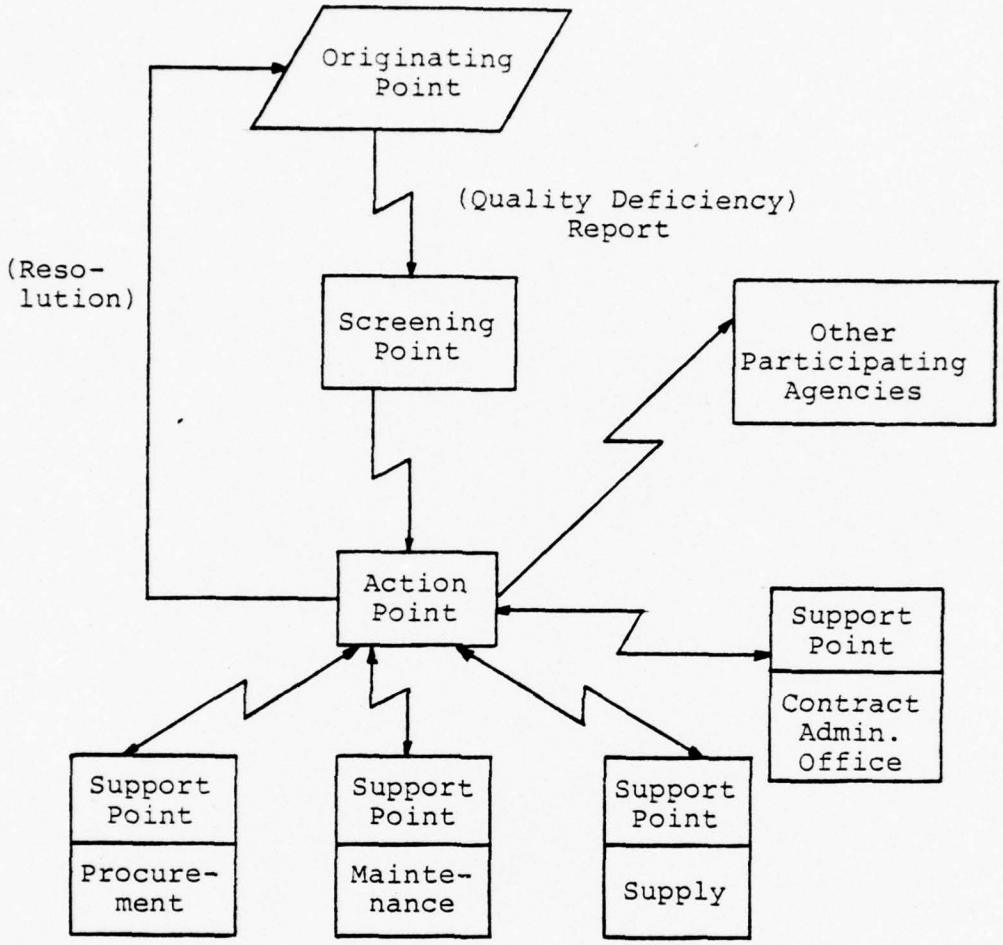

Fig. 1. Quality Deficiency Report Resolution Process Flow Chart (27:1-4)

the results to the originating point and other participating agencies as required (27:2-2). After dissemination of findings, the action point is required by AFM 12-50, *Disposition of Documentation*, to file and retain the documentation for a minimum of one year (22:10-229).

Exception to Routing Procedures

An exception to the routing and processing procedures described occurs when the deficiency report involves the 59 Federal Stock Group (FSG) items supplied by the Defense Electronic Supply Center (DESC) or the Defense General Supply Center (DGSC). TO 00-25-115, *AFLC Maintenance Engineering Management Assignments*, and TO 00-35D-54 require that deficiency reports on most items supplied by DESC or DGSC be directed to AFLC/LOIET, a branch of the Engineering and Technical Support Division at Wright-Patterson AFB, Ohio. TO 00-25-115 gives a breakout of the 59 FSG into classes (Appendix B, Table 4), and provides instructions on where to submit deficiency reports for each of the classes (20:1).

QDRs submitted on 59 FSG items can follow two different routing procedures. The routing is determined by the type of QDR submitted.

Category I and Internal Air Force QDRs

Category I Reports received by the Engineering and Technical Suppport Division (LOIE) are screened and

forwarded to the applicable equipment specialist in the Technical Support Branch (LOIET) for action (11:2). The equipment specialist evaluates the report and determines what actions are required to determine the cause of the deficiency. Repetitious reports are consolidated with existing reports (if any) that are under investigation (8:2). If the deficiency is not a repeat, an investigation is conducted with the collaboration of the support points to resolve the deficiency (Figure 2).

Category II reports follow the same routing if they are judged to be the result of actions internal to the Air Force. The decision to handle some of the Category II QDRs in this manner is made by the equipment specialist based on his experience and knowledge. LOIET retains action point responsibility for this relatively small number of reports (8:2).

Category II QDR

Category II QDRs are received and screened by LOIE. Properly routed QDRs are forwarded to LOIET (Figure 3).

The equipment specialists evaluate the report and screen the records for previous deficiency reports submitted on the same item. If the report is determined to be other than a valid quality control deficiency, the problem is reidentified and processed according to

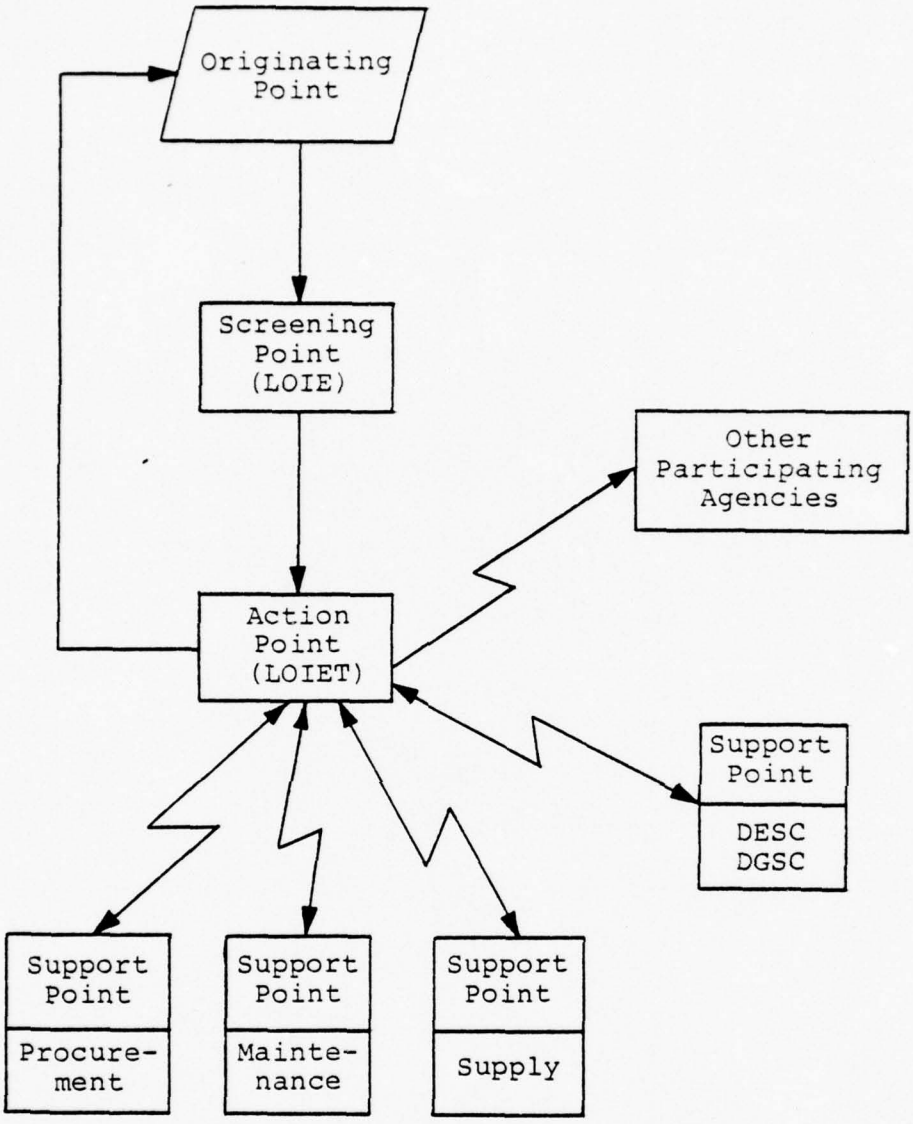

Fig. 2. Category I and Internal Air Force QDR Process Flow Chart (13)

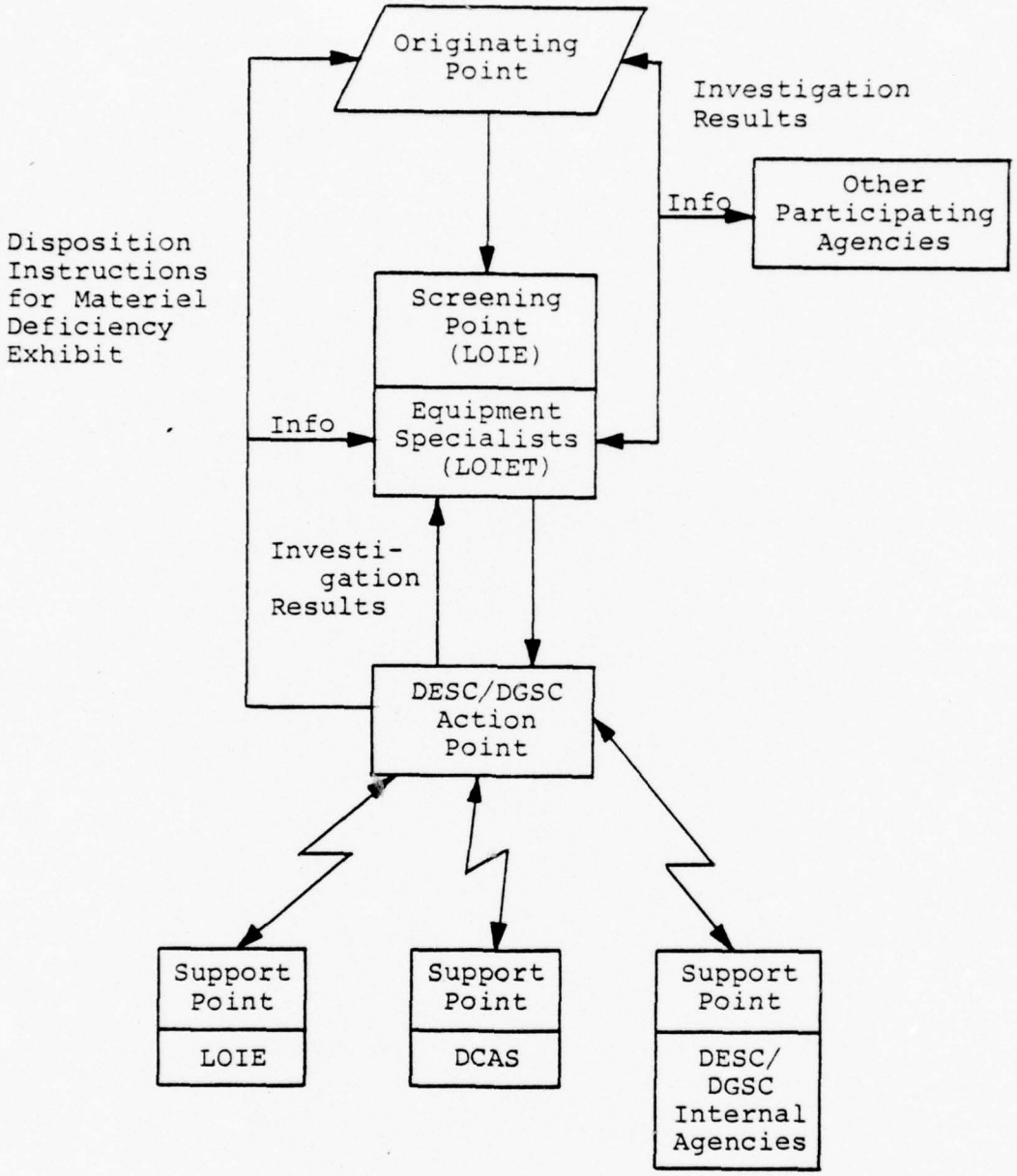

Fig. 3. Category II Report Resolution Process Flow Chart (13)

directives covering that particular problem. A valid quality control deficiency is defined as:

> A deficiency in material which is attributable to ineffective quality control such as nonconformance to applicable specifications, drawings, standards, technical orders, or other technical requirements for material configurations. This includes such deficiencies as error in workmanship, omission of work operations during manufacture or repair, failure to provide or account for all specific parts, improper adjustment, or other condition of nonconformance during manufacture, repair, modification, or maintenance of material [16:3-1].

If a deficienicy had been previously identified and further action is not required, the report is closed and the originator advised of the action (11:2).

If the deficiency had been judged to be a valid quality deficiency and not previously investigated, the report is sent to DESC or DGSC for action (11:2). DESC or DGSC becomes the action point and assumes responsibility for resolution of the deficiency including the necessary collaboration with the support points.

When the deficiency is resolved, DESC or DGSC will send the results of the investigation to LOIET. The results are evaluated by the specialist responsible for the item and if the investigation has adequately resolved the deficiency, the report is closed (11:2).

Regardless of the processing route followed, once the deficiency has been satisfactorily resolved, LOIET is responsible for notifying the originating point and

and other participating agencies. The QDR and written resolution[3] are then filed for historical purposes.

The QDR historical files maintained by LOIET provided the source of data for this research. Chapter III discusses the methodology developed to extract the data and to address the research questions.

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[3]When final determination of cause of failure was made, a written statement of that cause was made and attached to the QDR. The written statement or resolution is maintained with the filed QDR.

CHAPTER III

METHODOLOGY

This chapter describes the methodology used to address the research questions. Limitations concerning the data instrument used are explained and the population and sample of interest are examined. The sampling plan that was used is reviewed and support for validity of the data and representativeness of the sample is presented. Data collection problems are examined next and the final section discusses consolidation and grouping of the sampled data.

Data Instrument

Common use electronic and general supply items for the military departments and other federal agencies are supplied by the Defense Electronic Supply Center (DESC) and Defense General Supply Center (DGSC). These two agencies handle twenty-two of the twenty-three classes of commonly used electrical and electronic parts which make up 59 FSG (see Appendix B, Table 2). A more precise definition of electrical and electronic parts is provided in AFLCM 74-12, *Material Management Quality Assurance Program*:

> Hardware--Electrical and Electronic. Included in this group are tubes, capacitors, resistors,

transitors, diodes, wire, cable, transformers, inductors, crystals, connectors, sockets, terminals, and switches [16:3-12].

In 1975 the Defense Electronic Supply Center centrally managed some 656,100 items of electrical and electronic hardware in twenty-seven federal supply classes (3:16). Four and one-half million requisitions were received and processed which represented a sales volume of some 219 million dollars. The Center procured more than 235 million dollars worth of electronic parts and base support items, and 45 percent of gross sales were to the Air Force (19:17). The Defense General Supply Center provided parts identified under five classes of 59 FSG (see Appendix B, Table 4). These statistics are incorporated to indicate the volume of parts which were supplied by these two agencies.

Two limitations must be considered concerning submission of QDRs on electrical and electronic parts. First, not all QDRs submitted on these components are directed to LOIET. This organization was responsible for QDRs on items in the 59 FSG (27:3-5). This amounted to approximately half of the total QDRs submitted on electrical and electronic hardware in any one month.[1]

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[1]AFLCM 74-12 provides guidance for preparing a Quality Deficiency Data Analysis Summary (LOG MMX (M) 7102) which summarizes the number of valid deficiencies received (16:3-4). In the first five months of 1976, 1,048 QDRs were submitted on electrical and electronic hardware and 509 of these were directed to LOIET. These

This study was concerned with only those QDRs submitted on items in the 59 FSG. Second, a small group of QDRs submitted on 59 FSG items were excluded from this population. This occurred because one specialized class (out of twenty-three classes) in that Group was the responsibility of the Warner Robins Air Logistics Center (ALC). Additionally, some items were coded to a particular weapons system for management and were identified by a two-digit suffix added at the end of the applicable stock number (20:1). QDRs on these stock items were routed to the ALC having prime responsibility for that weapons system (20:2). It was determined that more than 90 percent of all 59 FSG QDRs were received and processed by LOIET (13).

Population

The resolution contained in the completed QDR folder identified the specific cause of the electrical or electronic hardware failure. It was these causes of failures identified in QDRs submitted to LOIET, Headquarters Air Force Logistics Command, during the years 1974, 1975, and the first five months 1976, that were the population of interest.

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totals were extracted from the Quality Deficiency Data Analysis Summaries for January-May, 1976.

Validity

Support for the validity of the data is provided by a discussion of the possible errors which could occur in the data and the means by which the errors were minimized.

The customer or orgininating point served as the initial screening agency in assuring that only quality deficiencies on materials as outlined in TO 00-35D-54 were submitted. Conditions and equipment which were not to be reported in accordance with the provisions of this technical order are specifically listed in Table 1-1 of TO 00-35D-54 (27:1-5,1-6).

A second screening occurred when the Chief of Maintenance or the Office in Charge (OIC) of the Quality Control Activity signed the report to indicate that a comprehensive review of the report had been performed. This helped to insure that the form was filled out correctly and that it had been properly routed (27:4-3). As an added measure of precaution, AFLCM 74-2 strengthened the reporting process by requiring that Quality Assurance Specialists *must* comply with the provisions of TO 00-35D-54 (15:4-2).

A final screening occurred when the transmitted QDRs were received by the equipment specialist responsible for determining the cause of failure. The specialist examined the background information contained in the formal writeup and decided whether the complaint appeared

to be valid. This decision was made by the specialist based on a considerable degree of knowledge and experience accummulated over a number of years. If the QDR was deemed to be valid the specialist processed the report. Those that were invalid or lacked information were returned to the screening point for additional action (11:2).

The final assurance of validity is made in regard to those dispositions in which a Materiel Deficiency Exhibit was used by the investigating agency. In cases where there was some difficulty determining exactly what the cause of failure was, the specific item of hardware that failed was submitted for technical and engineering analysis (27:1-3). Precedence of handling was determined by the category of report involved, and all exhibits were torn down and analyzed under the Teardown Deficiency Reporting System procedures authorized by AFR 66-30 (24:2).

This discussion was not intended to imply that the data obtained was error-free. However, the assumption made was that the number of inappropriate submissions was minimized.

Sample

A randomly obtained sample was taken from all available QDR resolutions on file. Since each resolution identifies a cause of failure this was essentially

a simple random sample of the possible causes contained in the entire population. Each element of the population had an equal and independent chance of being included in the sample.

Sampling Plan

The final Category II QDR dispositions were placed in folders arranged sequentially by federal stock class under the 59 FSG. The Category I dispositions (MIPs) were filed in separate file cabinets using the same filing system. A random sampling technique was used to extract the sample. The following formula was used to determine the maximum sample size from a known finite population considering a desired level of confidence/reliability (23:13).

$$n = \frac{N(Z^2)(p)(1-p)}{(N-1)(d^2)+(Z^2)(p)(1-p)}$$

where:

n = Sample size

N = Population size

p = Maximum sample size factor

d = Desired tolerance

Z = Factor of assurance for desired confidence level (23:13).

The population size was determined by counting the QDRs on file at LOIET. A population size (N) of 1,872 was found.

The value of p was estimated so that n could be found. The most conservative value of p ($p=0.5$) was chosen so that the sample size was large enough to insure that the desired precision was delivered (23:12). This caused p ($1-p$) to be the largest value possible.

A confidence level of 95.5 percent ($\pm 2\sigma$) was chosen. The desired tolerance (d) was selected at ±5 percent. These two choices allowed the researchers to be 95.5 percent confident that the true population statistic lies somewhere within the interval ±5 percentage points from the sample statistic (23:13).

The necessary sample size was calculated to be 319 with:

Z = 1.96

d = 0.05

p = 0.5

N = 1,872

Representativeness

There were several factors which support the representativeness of the sample. First, the size of the sample itself in relation to the population of interest should help to insure that it was representative. Second, there were twenty-three stock classes

of interest in the population and twenty of the classes were represented in the sample. Third, the time span covered by the sample was identical to that of the population. These three factors help insure that the sample was representative of the population from which it was drawn.

Collection of Data

The data instruments were maintained as historical documentation by LOIET. They were contained in eleven file drawers, separated by year and Federal Stock Class (FSC) in the case of Category I QDRs, and by class only for Category II QDRs. A filing system change was underway at the time the sample was drawn which complicated the sampling process.

QDRs were kept separate from other investigative reports generated by LOIET with the exception of those submitted against parts in three FSCs. FSC 5960, 5961, and 5962 QDRs had been integrated with two other report types due to partial implementation of the new filing system. In the case of these three classes, it was necessary to examine each report, mark those that were QDRs, and count the total QDRs found in the file. The task was considerably complicated but there was no erosion of sample accuracy.

The QDRs filed separately were also counted and the total found was used to derive a sample size appropriate to the statistic accuracy desired. A random number table (12:629) was then used to select 319 random numbers between 1 and 1,872. These numbers were then ordered and the sample was drawn beginning with Category I QDRs and proceeding through the Category II QDRs.

As each data instrument was drawn, the resolution identifying the cause of failure of that component was examined and the necessary data extracted. In cases where the resolution was not sufficiently clear, additional investigative documentation included with the QDR was used to determine the part cause of failure. If a question still arose as to the appropriate cause, the equipment specialist responsible for that component was consulted. Some problems in interpretation did occur and these will be addressed in Chapter IV.

The data were recorded by cause of failure and component class and supplemental information necessary for the analysis was also noted. All of the 319 individual elements employed in this study were selected and recorded in this manner.

Research Question One

In addressing this question the researchers consolidated component failures which were traced to the

same cause. These failure causes were then arrayed in a manner which answered the question, "What causes of failures in electrical and electronic parts can be identified?" Further discussion of these failures is found in Chapter IV.

Research Question Two

Research question two, "Is any particular area(s) responsible for a large proportion of quality failures?" was addressed by grouping the data in various ways. Three methods of grouping the data were considered and are briefly described in the following discussion.

First, an effort was made to determine the life span of the failed components. The supplemental information contained in the QDR folder was used to determine the time of failure of the component (if available). If the contract under which the part was purchased was known, a manufacture data could be found. The life span was then determined and grouping by life span was accomplished. Second, failure causes were grouped, when possible, by the function responsible for the failure. When causes could be associated with some general function, they were grouped according to that function. Finally, grouping by causes based on technical aspects of the parts was undertaken. The technical aspects considered were: technical orders, manufacturer specifications, and design

problems. Further discussion of the grouping efforts is undertaken in the next chapter. Again, the results obtained from grouping the data were used to address research question number two.

The following assumptions and limitations were made with respect to the research effort.

Assumptions

1. A minimum of invalid QDRs were submitted because of the multiple screening procedures which each must undergo.

2. The experience, judgement, and accurate investigation of equipment specialists resulted in failure causes being accurately identified.

3. All completed QDRs investigated in the years 1974, 1975, and the first five months of 1976 were on file with LOIET.

4. The time period investigated was of sufficient length to yield valid data pertaining to the objectives of this study.

5. The sample was not biased by the exclusion of those observations (10 percent of 59 FSG) noted.

Limitations

1. Inferences can only be made to the population. The Quality Deficiency Reporting System may be used to report perceived quality deficiencies on a variety of

components having dissimilar characteristics. This study only concerns reports on the 59 FSG items as delimited.

2. Historical data were not always complete.

3. The relationships derived from this research may be caused by other variables that were unknown at the time of the research effort.

Particulars of the data grouping and results obtained in the analysis are presented in Chapter IV, Data Analysis.

CHAPTER IV

DATA ANALYSIS

In this chapter the data obtained, using the methodology developed in Chapter III, are analyzed and discussed. The failure causes evident in the sample are enumerated and interpretation problems considered. These causes are then used to address the first research question. A second section is devoted to consolidating failure causes in ways conducive to addressing research question number two. Finally, the data are arrayed in a manner which allows analysis of Federal Stock Classes (FSC) within the 59 FSG.

Identification of Failure Causes

Twenty-three distinct causes of failure were identified in the sample of 319 QDRs. All of the failure causes are examined in the following discussion and a summary of these causes, catalogued alphabetically and defined, is displayed in Appendix C. In some cases, these causes were clearly evident from the resolution examined during sampling, while in others, analysis and interpretation of the data was necessary to identify failure causes. For purposes of presentation, the more difficult causes are treated initially, followed by a discussion of the more apparent causes of failure. Of the twenty-three

causes identified, eight are contained in the former and fifteen comprise the latter.

The resolution attached to each sampled QDR contained the final result of the investigation into the part failure for which the report was submitted. The resolutions were written by the equipment specialist who handled the investigation. DESC technicians were responsible for most of the causal research and the final determination of cause of failure but the final writeup was done by LOIET. Some variation occurred between the wording of the research findings and what was used on the final resolution. This variation required the researchers to examine more closely what was intended before assigning a specific cause of failure.

The terms "latent defect" and "random failure" were often used during research investigations and on final resolutions. At times, these terms appeared to be synonymous but on other occasions investigative documentation indicated that the technician perceived some difference between the two. Since a total of 103 QDR resolutions (32.3 percent) attributed component failure to one or the other of these terms, it was necessary to clarify exactly what was meant.

Explanations provided in discussion with equipment specialists were not sufficiently consistent to formulate a precise definition of either term. An

interview with the Chief, Quality and Reliability Branch, DESC provided the most usable definition of latent defect (10):

> G. The defect is caused by the development, in time of a change in the device. . . . The precise cause of this change is not always determinable nor is it predictable.
>
> H. At the time of manufacture, including the acceptance testing, there is no way to detect the latent conditions present in material that is meeting the test requirements of the specification.
>
> I. There is no known specific test or method that the Government could add over and above the test provided in the manufacturing and performance testing prescribed by contract that would specifically detect the presence of the latent characteristic that becomes unstable as a matter of time alone [18:2].

A random failure was then defined as a "first time" discovery of latent defect in a particular component (18). The difference in terminology existed primarily to notify users that a certain failed component may have had no history of failures. A computer system maintained by DESC was used to consolidate historical data of this nature and allowed the DESC Quality and Reliability Branch to determine whether a failure was new or recurring (19:30). From these explanations, it was evident that there was no difference in the cause of failure as indicated by "latent defect" or "random failure." It was also disclosed that the random failure term was being used less often because of the ambiguity between it and the term latent defect (10). Because the cause was listed both ways on resolutions in sample QDRs, both are retained

in the list of failure causes. The latest form letter used by DESC to report findings to LOIET (Appendix D) had deleted the term random failure although it may still be used in the remarks section in some cases.

Less than 1 percent of the sample resolutions identified cause of failure as being attributable to excessive shelf life. The definition of latent defect indicated that a number of components fail due to characteristics which become evident with the passage of time. This would seem to make these two types of failures much the same. It was not possible to discern any difference in the two causes from the research documentation but the different terminology was retained by the researchers.

A second complication arose because a number of resolutions (9.7 percent) did not identify a cause of failure but rather indicated reasons why an investigation could not be conducted. The three reasons identified were: Materiel deficiency exhibit destroyed, QDR misrouted, and QDR not properly submitted. A brief discussion of these three reasons follows.

TO 00-35D-54 required users submitting a QDR to hold the defective item for thirty days. This holding period was to allow the investigating agency enough time to make a cursory examination, to decide whether the defective item should be submitted for tear-down analysis, and to provide dispostion instructions to the user (27:5-2).

Due to a misinterpretation of holding instructions, organizations submitting 5 percent of the sampled QDRs destroyed the materiel deficiency exhibit. This made determination of the cause of failure impossible in some cases.

The other two reasons involved QDRs either misrouted or improperly submitted. Four levels of screening occurred for each QDR submitted and yet it appeared that 4.7 percent contained either insufficient or incorrect information to allow processing or they were delivered to the inappropriate action point. Those QDRs that were misrouted were forwarded to the proper location but valuable time was consumed in the process. In some cases, the total time consumed may have exceeded thirty days which would result in the materiel deficiency exhibit being destroyed. Those with insufficient or incorrect information were closed out because requests for additional clarification went unfulfilled.

One other aspect of the data must be mentioned. A small proportion of failures were attributed to technical orders that were not correct or to shipping and handling damage. These failures were evident in 2.2 percent of the QDRs submitted. These were instances in which technical order or shipping and handling causes were not visible in any way to the user when the QDR was submitted. TO 00-35D-54 requires the user to submit suspected technical order or packaging and handling

deficiencies to other agencies (27:1-4,1-5). Therefore, the 2.2 percent of sample QDRs that were identified to these causes and were applicable to 59 FSG items were in addition to those sent directly to the appropriate agencies.

Fifteen of the causes existing in the sample did not appear to be subject to misinterpretation. These causes were clearly delimited by the QDR resolution and associated investigative documentation. The causes included in this list are briefly discussed in the following paragraphs.

DESC Shipped Wrong Part. In 2.8 percent of the cases DESC shipped the wrong part to the using activity. The component was identified as unusable by maintenance or failed in service and a QDR was submitted. The exact reason for the oversight was not identified to any particular DESC activity.

No Quality Defect Found. A large number of failed components were found to have no assignable defect when the materiel deficiency exhibit was submitted for examination. More than 9.1 percent of the sample met all specifications identified in procurement drawings.

Normal End-of-Life Failure. Some failures were confirmed by testing (6.3 percent) but the part had

exceeded the anticipated life span expected of that variety of component. None of the identified parts had a specific life span identified in specifications but they had all exceeded what the equipment specialist, based upon his experience, considered to be an "average" life.

Operating Limit of Part Exceeded, Part Failed But No Longer Stocked in Inventory, Other. In all three cases only one QDR was identified to a failure cause. In the first case the operating limit of the part had been exceeded but no specific reason why this occurred was discernable from the research documents. The second case acknowledged a failure but the component was no longer carried in the inventory. Since the investigation would be unlikely to be of benefit to anyone, the QDR was closed without action. In the last case it was not possible to determine what action had been taken on the QDR. Only one instance of this occurred so that one element was charged to a cause factor called Other.

Defect Attributed to Manufacturer. Fifty-six of the sample resolutions (17.6 percent) attributed failure to inappropriate actions by the part manufacturer. Among the reasons specified were ineffective quality control, use of contaminated components, and poor workmanship.

Defect Caused by Fault in Related Circuit or System. In 5.6 percent of the sample cases, maintenance caused the failures to occur. Such mistakes as failure to follow the technical order tuning procedures, overstress of components during installation, and leaving out heat sinks required for certain parts were examples of technician nonconformance.

Defect Verified But Contract No Longer in Existence. In the four cases observed, contracts under which the part was procured had elapsed. In one instance the contractor had gone out of business so no recourse could be had against the manufacturer. The QDRs were closed administratively.

Inappropriate Substitution of Parts. Failure of 2.2 percent of the sample resulted when suppliers (DESC or base level) delivered an item which had been inappropriately substituted. For example, a tube was listed as a substitute in general use but was not suited for the specific location where it was utilized.

Manufacturer Did Not Conform to Specification or Procurement Drawing. These four failures were attributed to the manufacturer failing to conform to specific requirements included in specifications or procurement drawings. In two cases this appeared to have been due to an oversight.

Misapplication of Part (Design). Original design or modification of existing circuitry utilized a component with characteristics insufficient to meet the stated requirements. When the part was used in the circuit, it failed at once or in a short period of time. This type of failure was evident 2.8 percent of the time.

Procurement Drawing Did Not Adequately Describe the Part. The drawings provided the manufacturer were defective 2.2 percent of the time. The procuring agency provides these drawings in most cases.

Supply Issued a Previously Failed Part. In 1.3 percent of the cases, failed items turned in to supply functions for credit were released to other users. This resulted in a perceived failure and submission of a QDR.

In all instances where questions arose concerning the exact cause of failure, the cause listed by the equipment specialist examining the failure was retained and listed. More subjective appraisal of these findings was made in discussing research question two. The findings as presented were used to address research question one.

Research Question One

Research question one asked "What causes of failures in electrical and electronic parts could be

identified?" The failure causes identified in the preceding discussion answer this question. The twenty-three causes of failure identified and the number of their appearances in the sample are summarized and presented in Table 2.

Data Groups

In order to address research question two an attempt was made to group the failure causes identified earlier in three different ways. Two of these ways were more successful than the third.

First, the data were examined for information about the time of failure. By relating the time of failure back to the time of manufacture, certain components with critical life spans might be identified. Three problems arose that complicated this approach. First, although the time of failure could be assumed to be the day the QDR was submitted, the date of manufacture was difficult to find with any assurance of accuracy. Many components could be traced to the contract under which they were purchased. Unfortunately, many parts are purchased under contracts that are long running and require periodic delivery of large numbers of identical parts. Since most parts in 59 FSG are not controlled by serial number, only a very general manufacture time was determinable. Second, only 53 percent of the sample

TABLE 2

IDENTIFIED PART FAILURE CAUSES

Cause of Failure	Number of Occurrences	Percent of Total
Damaged in shipping or handling	2	.63%
DESC shipped wrong part	9	2.82
Defect attributed to manufacturer	56	17.55
Defect caused by fault in related circuit or system	6	1.88
Defect considered random in nature	38	11.91
Defect direct fault of maintenance action	18	5.64
Defect verified but contract no longer in existence	4	1.25
Failure attributed to excessive shelf-time	2	.63
Inappropriate substitition of parts	7	2.19
Latent defects	65	20.38
Manufacturer did not conform to specification or procurement drawing	4	1.25
Materiel deficiency exhibit not available for investigation	16	5.01
Misapplication of part (design)	9	2.82
Misrouted QDR	7	2.19
No quality defect found during investigation	29	9.09

TABLE 2--Continued

Cause of Failure	Number of Occurrences	Percent of Total
Normal end of life failure	20	6.27%
Operating limit of part exceeded	1	.32
Other	1	.32
Part failed but no longer in inventory	1	.32
Procurement drawing did not adequately describe the part	7	2.19
QDR not properly submitted	8	2.15
Supply issued a previously failed part	4	1.25
Technical Order not correct	5	1.57

was determined to have failure causes in which time could be a factor. Third, the sample size was not sufficient to indicate any trend. The largest class of parts found in the sample had only 92 QDRs submitted against it and less than 47 percent of these were due to failures where time could be considered to be a factor. In light of these findings, it was decided that grouping by time of failure was not feasible.

Second, the possibility of grouping failure causes by the function responsible for that cause was considered. The sample was of insufficient size to allow any specific organization to be identified as causing a large number of failures. However, it was possible to view functional areas as being responsible for failures. For example, the manufacturer was named as the cause in 53 percent of the reported failures. Grouping by functional areas is discussed in greater detail in the next section of this chapter.

Finally, certain technical aspects may have been responsible for many failures. Three of the failure causes previously identified concern specifications, original or modification design, and technical orders. It was possible to group some causes by technical considerations.

Grouping was accomplished using the techniques just described. The following groups were created, based

on common characteristics, from failure causes identified in the 319 QDRs contained in the random sample. Subsequent discussion and analysis of these groupings will provide validity to the conclusions.

Group I: Manufacturer Related Defects. The objective of grouping the data in Group I was to identify those failures which could be attributed to the manufacturer of the part. Failures specifically recorded as resulting directly from actions taken by the manufacturer were included. QDRs that resulted in the failure cause being identified as the result of the contractor not conforming to the specifications or procurement drawings provided to him by the procuring activity were included. Also included were cases where the defect was verified by the investigating agency but the contract was no longer in existence. In these cases, action could not be taken to obtain compensation from the contractor because the contract was no longer valid. Latent defects caused by the development, over time, of a change in a device were included in this group because the contractor was legally required to replace failed items at no cost to the government (18). Also included were random defects which were valid quality defects but no previous failures of the part had been reported. This type of defect was attributed to the manufacturer and a record of the failure was kept to

determine if a failure trend developed. The final failure causes contained in this group were those defects resulting from the part encountering excessive shelf time between manufacture and eventual use.

Group II: Defect Attributed to Maintenance Actions. The failure causes consolidated in this group were attributed to maintenance related actions that resulted in part failure. Failures that occurred as a result of a fault in related circuitry or the system itself were included because, as noted on the QDR resolutions, proper troubleshooting procedures would have identified the fact that the failure did not occur as a result of the quality of the part.

Group III: No Quality Defect Found. This group is comprised of those resolutions where failure was the result of the part having already exceeded its expected life span, or those where the investigation concluded that no quality defect actually existed. For example, a tube was reported as defective under the deficiency reporting system but when the action agency examined the tube during the course of the investigation, the tube met or exceeded all requirements/specifications.

Group IV: Materiel Deficiency Exhibit Not Available for Investigation. Group IV consists of those QDRs sampled where it was found that an investigation could not

be accomplished because the Materiel Deficiency Exhibit was not available for use in determining the cause of failure. In this group were instances of the using organization disposing of the exhibit before the required thirty day holding period had expired or the exhibit being lost during shipment of the part to the action point for investigation purposes.

Group V: Supply Related Deficiencies. The QDR resolutions combined in this group were those in which the investigating agency concluded that the failure, or perceived failure, resulted from actions that occurred in the supply channel. Included were defects resulting from damage that occurred in handling or shipping the part, and those failures that resulted because the procurement drawings in the purchase contract did not adequately describe the part needed. Additionally, resolutions where the investigation concluded that base supply had issued a part that had been previously turned in by maintenance as inoperable, and those concluded to be the result of incorrect substitution of parts are included. The final resolutions included in this group were those where it was found that DESC or DGSC had shipped the wrong part when filling a supply requisition.

Group VI: Technical Order Not Correct. The failure causes included in this group were those where the

Technical Order was found to be a contributing factor. The Technical Order was found to contain incorrect information such as the wrong part number listed or incorrect tuning procedures, which, when followed, resulted in part failures.

Group VII: Part/Equipment Incompatability. Defect causes incorporated in this group were those attributed to the operating limits of the part being exceeded during equipment operation which resulted in the subsequent failure of the part. Also included were those causes judged to be the result of design deficiencies. For example, environmental factors such as high temperature and humidity or stress of the operating environment were not taken into consideration during the initial design of the part, resulting in the eventual failure of the part.

Group VIII: Other. Failure causes in this group consist of those failures where the cause could not be identified from the information contained in the final QDR resolution, cases where the report was administratively closed because the QDR had not been properly submitted, or instances where the report had been misrouted to LOIET and was the responsibility of another action point. One resolution resulted in the failure being verified, but no further action taken because the part

was no longer stocked in the invetory. This particular case was also included in this group.

Research Question Two

Research question two asked, "Was any particular area(s) responsible for a large proportion of quality failures?" The twenty-three causes of failure identified while answering research question one were consolidated in the eight groups described previously. These groups were used, in the following discussion, to address the research question. Table 3 displays the results of this grouping. For an expanded presentation of failure causes contained in each group see Table 5, Appendix B.

Federal Stock Group Analysis

Group I failure causes accounted for 53 percent of all failures. Within this manufacturer related group, a large percentage was found to be defects considered latent and random in nature. A total of 103 defects or 32.29 percent of the entire sample were attributed to these two failure causes; within Group I they were responsible for 61.68 percent of the total. Fifty six of the 319 QDRs sampled were found to be caused by actions directly traceable to the manufacturer of the part. These discrepancies, such as errors in workmanship or other conditions that could be traced to nonconformance during manufacture accounted for 17.55 percent of all identified failure causes.

TABLE 3

GROUPED FAILURE CAUSES

Group	Identifier	Number of Occurrences	Percent of Total
I.	Manufacturer Related Defects	169	53%
II.	Defect Attributed to Maintenance Actions	24	8
III.	No Quality Defect Found	49	15
IV.	Materiel Deficiency Exhibit Not Available	16	5
V.	Supply Related Defects	29	9
VI.	Technical Order Not Correct	5	2
VII.	Part/Equipment Incompatibility	10	3
VIII.	Other	17	5
	Total	319	100%

Defects caused by maintenance actions were the identified failure cause in 8 percent of the QDRs sampled. Defects identified as the direct fault of the action of maintenance technicians were in excess of 5 percent of the total. Fifteen percent of the QDRs sampled resulted in an investigative finding of no quality defect found. Approximately 9 percent of the investigations found that the "so-called" defective part actually met or exceeded required standards when tested. In 5 percent of the cases, an investigation into the reason for failure could not be conducted because the Materiel Deficiency Exhibit was not available for testing purposes.

Group V failures causes were found to have occurred in 9 percent of the sample. The largest contributing cause within this Group was the shipping of an incorrect part by DESC of DGSC when filling supply requisitions. Defects resulting from incorrect Technical Orders accounted for 2 percent and an additional 3 percent was attributed to the operating limits of the part being exceeded or misapplication of the part in a particular component.

The final Group, Other, amounted to 5 percent of the sample. Problems in the submission of QDRs, such as misrouting or incomplete information on the report, accounted for the majority of failure causes within this group.

Federal Stock Class Analysis

The previous discussion focused on the 59 FSG in its entirety. In addition, analysis was accomplished by individual FSC within the 59 FSG. Figure 4 shows the number of QDRs in the sample that occurred in each class. Table 6, Appendix B, provides the data in tabular form.

FSC 5960, 5930, and 5961 contained 60.8 percent of all defects found in the sample. Within FSC 5960, which consists of electron tubes and associated hardware, Group I-type failures accounted for 46.65 percent and Group II 18.48 percent of the total failures. Group II causes accounted for approximately 10 percent. Figure 5 graphically depicts the percentages of failures by Group within FSC 5960.

Group I, Manufacturer Related Defects, caused 48.61 percent of the failures within FSC 5930; Group II, Defects Attributed to Maintenance Actions, approximately 14 percent; and Group III, No Quality Defect Found, 15.28 percent. FSC 5930 is composed of varied types of electrical switches. Figure 6 shows the percentages attributable to any particular Group within this FSC.

Only three groups of failure causes were found responsible for failures within FSC 5961, which consists of semiconductor devices and associated hardware. Manufacturer related failures accounted for 76.77 percent,

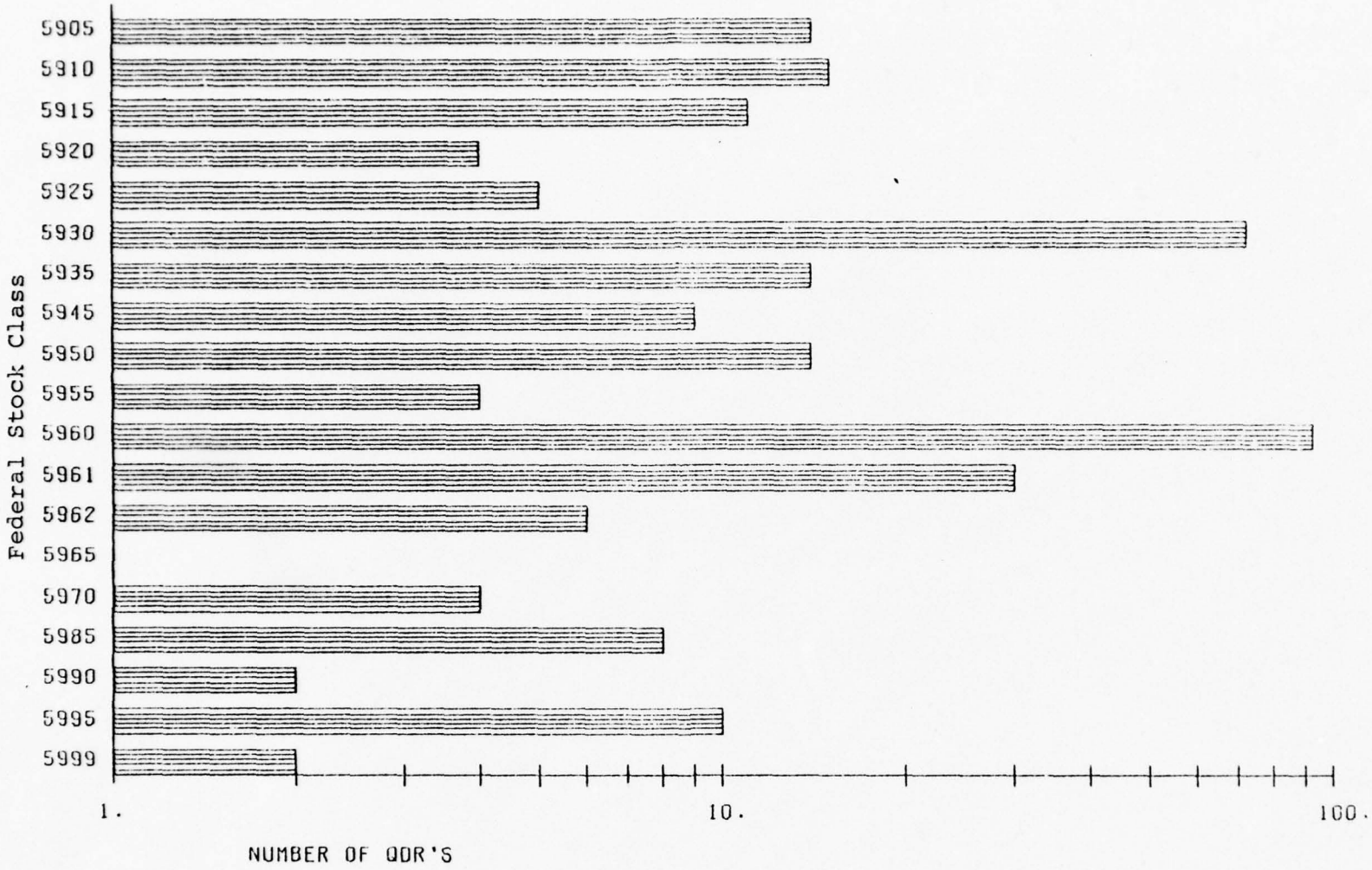


Fig. 4. Number of Quality Deficiency Reports per Federal Stock Class

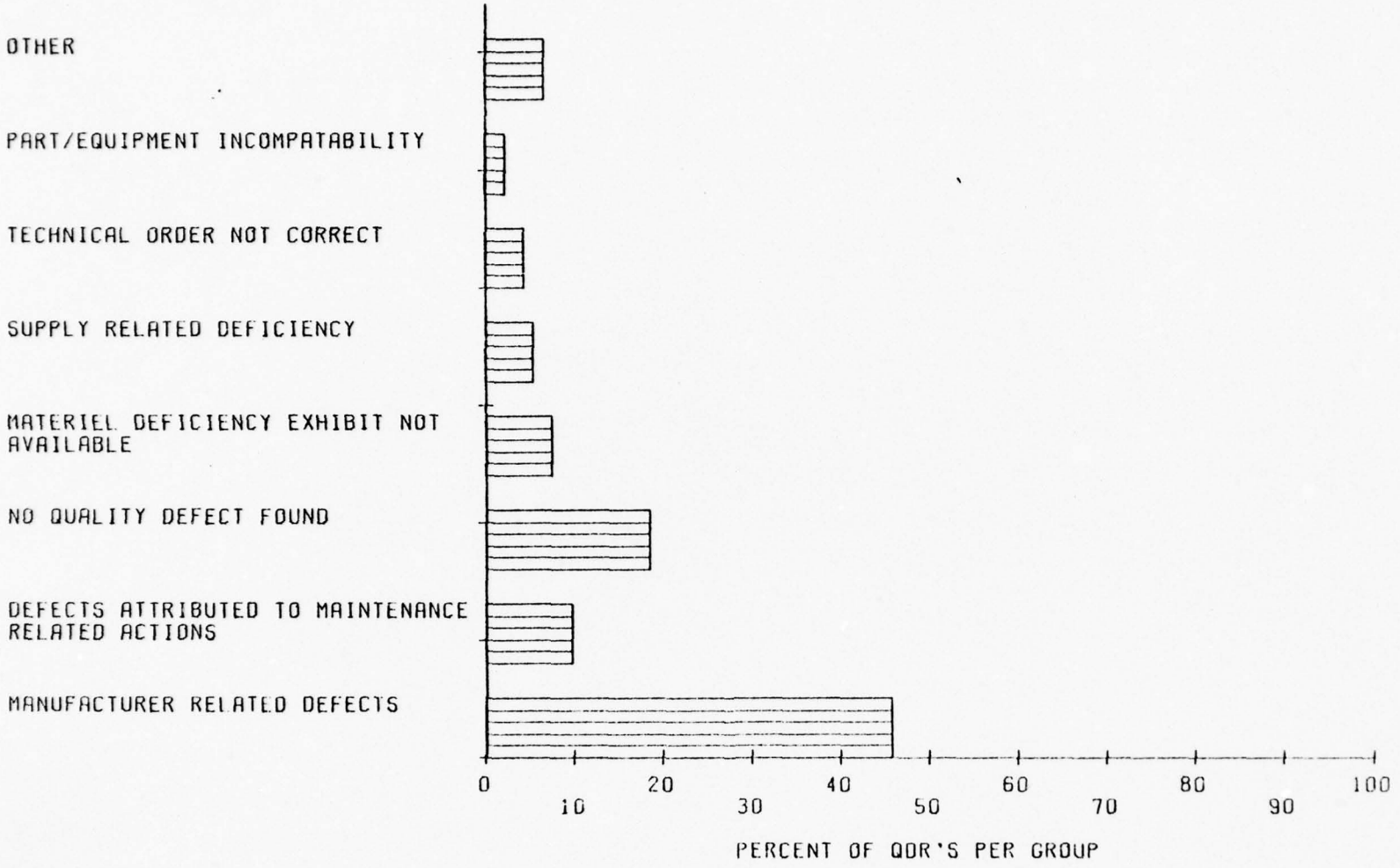


Fig. 5. Percent of QDRs from FSC 5960 in Each Group

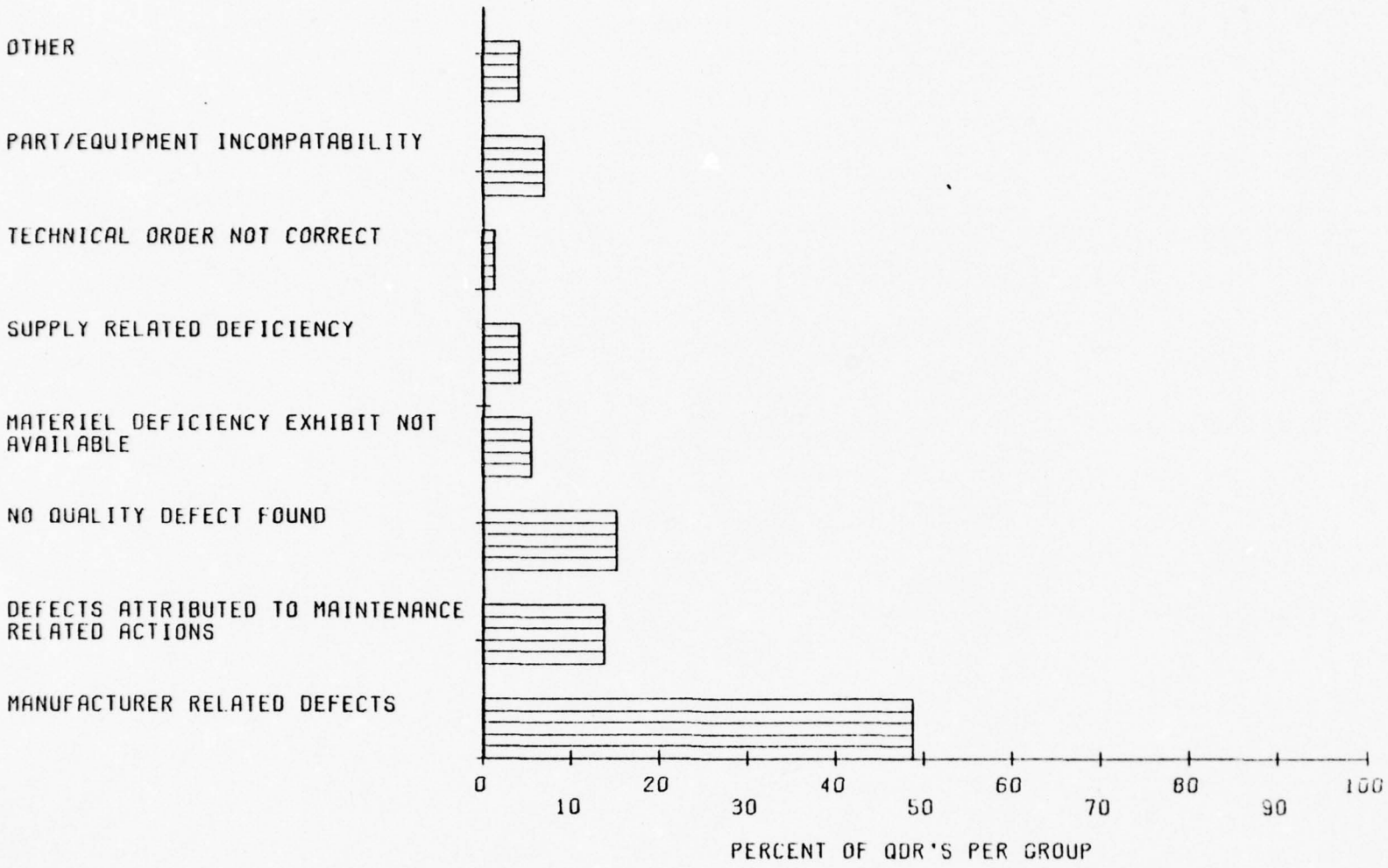


Fig. 6. Percent of QDRs from FSC 5930 in Each Group

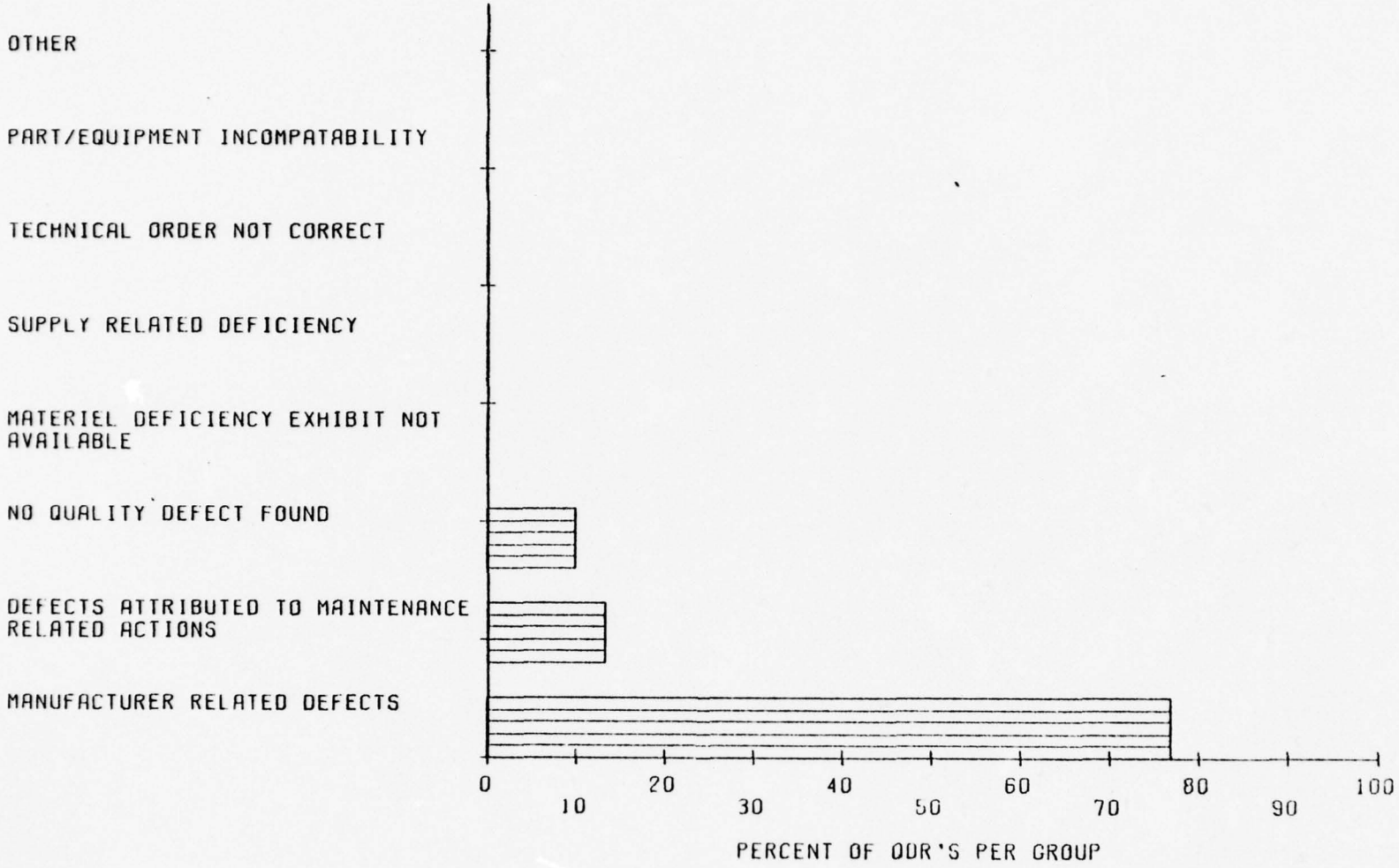


Fig. 7. Percent of QDRs from FSC 5961 in Each Group

maintenance related actions 13.33 percent, and no quality defect was found in 10 percent of the sample that occurred within this class. Figure 7 displays the failures by group within this FSC.

Six additional classes that accounted for ten or more of the QDRs sampled were arrayed by failure causes and are graphically displayed in Appendix E. Due to an insufficient number of QDRs, it was not possible to arrive at any valid conclusions concerning failures within these classes.

Conclusions and recommendations derived from this analysis are presented in Chapter V.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In this chapter, the results of the research effort are summarized and conclusions drawn from the study are discussed. In addition, as a result of the study, recommendations are made and future research topics are described.

Summary

There were two objectives to this research study. The first objective was to identify causes of failure in electrical and electronic parts. To accomplish this objective, an in-depth examination of the USAF Materiel Deficiency Reporting and Investigating System was undertaken. Quality Deficiency Reports submitted by using organizations under this system were the data instruments used to obtain the information necessary to determine failure causes.

QDRs submitted on common-use electrical and electronic parts purchased by DESC and DGSC were examined. The study was restricted to items within the 59 FSG which were the responsibility of the Engineering and Technical Services Division, Headquarters, Air Force Logistics Command.

A random sample was taken from the QDR resolutions on file at AFLC (LOIET) for the years 1974, 1975, and the first five months of 1976. From a population of 1,872 QDRs on file, a sample of 319 QDRs was obtained and analyzed. The failure causes were enumerated to allow identification of the causes of failure in 59 FSG commodities.

The second objective was to identify any particular area(s) responsible for a large proportion of quality failures. This objective was accomplished by incorporating the identified failure causes into distinct groups having like failure causes. These groups were then examined to identify area(s) where a high proportion of quality failures originated.

The conclusions and recommendations from the study follow.

Conclusions

Research Question One

Research question one asked, "What causes of failures in electrical parts could be identified?" The question was answered by enumerating the failure causes which appeared in the sample of QDRs submitted on 59 FSG parts. Twenty-three failure causes were isolated during investigation of the QDRs contained in the sample. Two considerations were relevant to these causes.

First, the failure causes found in the sample QDRs were arrived at by experienced and knowledgeable equipment specialists investigating perceived defects. The individual submitting the QDR did so because he had a legitimate question concerning a part which had failed. The individual may or may not have submitted a QDR that would inevitably identify a valid quality deficiency in a part; but he perceived it as such. In 47 percent of the cases the quality problem was not due to physical problems with the part. Failures occurred due to maintenance actions, supply related actions, technical order or procurement drawing deficiencies, misapplication of parts, or, in some cases, simply because of the age of the component. The resultant conclusion is that QDR submissions not only identify causes of failure in regard to parts but also with respect to the logistics system itself. And yet, the QDR is used primarily as a means of identifying and rectifying shortcomings in materiel. Consideration should be given to what implications are being made about other aspects of the logistics system.

Second, although only twenty-three failure causes were identified, the definitions attached to these causes were, in some cases, insufficiently clear. This shortcoming was accentuated when the user who submitted the report was attempting to comprehend the answer to his QDR. The terms "random failure," "latent defect," and

"shelf life" as discussed in Chapter IV were examples of different terms with much the same definitions. Credibility of the QDR system is dependent on a firm belief by users that their submissions elicit accurate responses and provide information which gives positive feedback to the materiel system. Anything less than clear and concise answers appear to be self-defeating.

Research Question Two

Research question two asked, "Was any particular area(s) responsible for a large proportion of quality failures?" This question was addressed by grouping the failure causes into distinct groups and examining the results. The following conclusions were made based on this examination of the group causes.

First, manufacturer caused defects represented a significantly high percentage of defects that occurred in electrical and electronic parts. By grouping those failures that could be attributed to manufacturer caused defects, it was found that 53 percent of all failures in the 59 FSG could be attributed to the manufacturer of the failed part. Second, a substantial proportion (15 percent) of the QDR resolutions concluded that no quality defect could be found.[1] Third, failures attributed to

[1]The resolutions incorporated in this group do not indicate a cause of part failure but rather serve as an indicator that something other than part quality could be a contributor to equipment downtime.

maintenance actions such as technicians not complying with accepted maintenance practices or procedures resulted in a high percentage (8 percent) of part failures. Fourth, QDR investigations that found the defect to be the result of problems in the supply channel such as the procurement drawings not adequately describing the required part occurred in 9 percent of those sampled. These types of problems may be resulting in unnecessary costs being incurred in the logistics effort.

Recommendations

1. The operating level Quality Control and maintenance personnel responsible for clearance and control of materiel deficiency reports must be made aware of two points:

a. Genuine rewards in terms of higher quality repair parts is possible if accurate, properly formatted reports are prepared.

b. Significant time, effort, and dollar losses occur when improperly completed reports are submitted. Slightly more than 25 percent of submitted QDRs were incorrect, misrouted, or involved parts that were not defective.

2. The action point should be providing more extensive and definitive explanations to organizations submitting QDRs. As discussed in the conclusions to research question one, some identified failure causes cannot be

specifically defined so as to preclude misunderstanding. When this condition occurs, and the variance in interpretation is minor, a method of grouping such as that used to answer research question two might be clearer and less subject to misinterpretation by the customer. Such groupings could be contained in the technical order with a more extensive explanation of the actions that are taken to preclude reoccurrence of the same problem.

3. Quality Deficiency Reports on common use 59 FSG parts should be submitted directly to DESC or DGSC without the intervening coordination of AFLC (LOIET). Communications are invariably complicated by placing a coordinating layer between the action point and the customer. Perhaps the greatest disadvantage in the present system resides in the insulating effect of LOIET which reduces the sensitivity of the action point to customer complaints.

Future Research

Based on the results of this research study and the experience gained by the researchers, the following research efforts are recommended as areas for future study.

1. That further research be conducted to replicate the results of this study and determine if similar

failure causes can be identified in other populations of QDRs. Since this study was restricted to QDRs submitted to LOIET (on parts in the 59 FSG), it is recommended that future study be applied to reports concerning failures of parts managed by an Air Logistics Center.

2. A comprehensive examination should be made of all existing manuals, regulations, directives, and operating instructions with consolidation and simplification of quality assurance direction as a goal. The proliferation of these directives, as reviewed in Chapter I, makes it extremely difficult for the manager to acquire a comprehensive knowledge of quality control procedures.

3. That a study be made of the DoDs use of sampling techniques during materiel acceptance, and the possible impact these techniques have on manufacturer related defects discovered during the investigation of QDRs.

APPENDIXES

APPENDIX A

GLOSSARY

APPENDIX A

GLOSSARY

Action Point

The activity responsible for the resolution of a QDR including necessary collaboration with support points (27:1-1).

Air Logistics Center

"An organization serving as a field agency of the Air Force Logistics Command in a specified geographical area. Its mission is to provide technical and administrative assistance and support of USAF activities based with the area [3:25]."

Defect

"Any nonconformance of a characteristic with specified requirements [29:2]."

Defective

"A unit of product which contains one or more defects [29:2.]"

Federal Supply Classification (FSC)

"A commodity classification designed to serve the functions of supply. The classification establishes

groups and classes for the universe of commodities with emphasis on the items known to be in the supply system of the Federal Government. The FSC uses a four-digit coding structure. The first two digits identify the group; the last two digits identify the class within the group [3:184]."

Federal Supply Group

"A commodity classification used in federal cataloging systems to group federal supply classes which are homogeneous [3:184]."

Nonconformance

"The failure of a unit of product to conform to specified requirements for any quality characteristic [3:4]."

Originating Point

The activity submitting the Quality Deficiency Report (27:1-1).

Part

Part is defined in MIL-STD-280, Par 2.1.1 as: "One piece or two pieces joined together which are not normally subject to disassembly without destruction of designed use." The terms "bit" and "piece" are used in maintenance circles to denote not only "part" as defined above, but also to indicate the lowest level of

disassembly for which replenishment will be obtained by procurement and made available through supply stocks (3:318).

Quality

The composite of material attributes including performance (21:1).

Quality Assurance

A planned and systematic pattern of all actions necessary to provide adequate confidence that material, data, supplies, and services conform to established technical requirements and achieve satisfactory performance (21:1-2).

Screening Point

The activity that determines the responsible action and forwards the QDR to the action point (27:1-1).

Specification

"A document intended primarily for use in procurement, which clearly and accurately describes the essential and technical requirements for items, materials, or services, including the procedures by which it will be determined that the requirements have been met. Specifications for items and materials may also contain preservation, packaging, packing and marking requirements [29:6]."

Support Point

"The activity that assists the action point in processing and resolving a deficiency, such as, contract administration office, engineering support offices, etc. [27:1-1]."

APPENDIX B

TABLES

APPENDIX B

TABLES

This appendix contains the following tables:

Table 4--Federal Stock Classes in the 59 FSG,

Table 5--Failures by Group and Cause,

Table 6--Number of QDRs per Federal Stock Class.

TABLE 4

FEDERAL STOCK CLASSES IN THE 59 FSG

FSC	Description
5905	Resistors
5910	Capacitors
5915	Filters and Networks
5920	Fuses and Lightning Arrestors
5295	Circuit Breakers
5930	Switches
5935	Connectors, Electrical
5940*	Lugs, Terminals, and Terminal Strips
5945	Relays, Connectors and Solenoids
5950	Coils and Transformers
5955	Piezoelectric Crystals, Nonstock Listed
5955**	Piezoelectric crystals, Except Nonstock Listed
5960	Electron Tubes and Associated Hardware
5961	Semiconductor Devices and Associated Hardware
5962	Microelectric Circuit Devices
5965	Headsets, Handsets, Microphones, and Speakers
5970*	Insulators, and Insulating Materials
5975*	Electrical Hardware and Supplies

NOTE: No asterisk--DESC

*DGSC

**Warner-Robbins ALC responsibility.

TABLE 4--Continued

FSC	Description
5977*	Eléctrical Contact Brushes and Electrodes
5985	Antennas, Waveguides and Related Equipment
5990	Synchros and Resolvers
5995*	Cable, Cords, and Wire Assemblies; Communication Equipment
5999	Miscellaneous Electrical and Electronic Components

SOURCE: U.S. Department of the Air Force. AFLC Maintenance Engineering Management Assignments. Technical Order 00-25-115. 23 July 1975.

TABLE 5

FAILURES BY GROUP AND CAUSE

Group Identifier	Number of Occurrences	Percent of Total
I. Manufacturer Related Defects		
a. Defects attributed to manufacturer	56	17.55%
b. Defect verified but contract no longer in existence	5	1.25
c. Defect considered random in nature	38	11.91
d. Failure attributed to excessive shelf time	2	.63
e. Latent	65	20.38
f. Manufacturer did not conform to specifications or procurement drawing	4	1.25
Subtotal	169	53* %
II. Defect Attributed to Maintenance Actions		
a. Defect caused by fault in related circuits or system	6	1.88%
b. Defect direct result of maintenance action	18	5.64
Subtotal	24	8* %

*Rounded to nearest whole decimal.

TABLE 5 --Continued

	Group Identifier	Number of Occurrences	Percent of Total
III.	No Quality Defect Found		
	a. Normal end-of-life failure	20	6.27%
	b. No quality defect found during investigation	29	9.09
	Subtotal	49	15* %
IV.	Materiel Deficiency Exhibit Not Available	16	5* %
	Subtotal	16	5* %
V.	Supply Related Defects		
	a. Damaged during shipping or handling	2	.63%
	b. DESC or DGSC shipped the wrong part	9	2.82
	c. Inappropriate substitution of parts	7	2.19
	d. Procurement drawing did not adequately describe part	7	2.19
	e. Supply issued a previously failed part	4	1.25
	Subtotal	29	9* %
VI.	Technical Order Not Correct	5	2* %
	Subtotal	5	2* %

TABLE 5--Continued

	Group Identifier	Number of Occurrences	Percent of Total
VII.	Part/Equipment Incompatibility		
	a. Operating limits of part exceeded	1	.31%
	b. Misapplication of part (design)	9	2.82
	Subtotal	10	3* %
VIII.	Other		
	a. Misrouted QDR	7	2.19
	b. Part failed but no longer stocked in inventory	1	.31
	c. QDR nor properly submitted	8	2.51
	d. Unable to determine cause of failure	1	.31
	Subtotal	17	5* %
	Grand Total	319	≈100 %

TABLE 6

NUMBER OF QDRs PER FEDERAL STOCK CLASS

FSC	Number of Occurrences	Percent of Total
5960	92	28.84
5930	72	22.57
5961	30	9.40
5910	15	4.70
5950	14	4.39
5905	14	4.39
5935	14	4.39
5915	11	3.45
5995	10	3.13
5945	9	2.82
5985	8	2.51
5962	6	1.88
5925	5	1.57
5920	4	1.25
5955	4	1.25
5970	4	1.25
5990	2	.63
5999	2	.63
5965	1	.31
Total	319	≈100

APPENDIX C

CATEGORY I AND CATEGORY II DEFINITIONS AND DEFINITIONS OF FAILURE CAUSES

AD-A032 328 AIR FORCE INST OF TECH WRIGHT-PATTERSON AFB OHIO SCHO--ETC F/G 15/5
AN APPRAISAL OF SELECTED FINDINGS OF QUALITY DEFICIENCY REPORTS--ETC(U)
SEP 76 T W WALLER, A L WEINMAN

UNCLASSIFIED SLSR-33-76B NL

2 OF 2
ADA032328

END
DATE FILMED
1 -77

APPENDIX C

CATEGORY I AND CATEGORY II DEFINITIONS AND DEFINITIONS OF FAILURE CAUSES

Category I and Category II Definitions

Quality Deficiency Reports are submitted as either a Category I or Category II Report. The Category I report is a report of:

> . . . an emergency condition on all types of equipment which presents, or has the clear potential to present, an unacceptable safety, operational, or maintenance hazard. These conditions are defined as follows:
>
> (1) Accident or Incident--An unexpected or unsought event that does damage to persons or property and is not caused by enemy action. . . .
>
> (2) Nuclear Safety Deficiency--Any materiel, engineering or design deficiency which could cause (or contribute to) a nuclear accident, incident, or deficiency, . . . Category I Report does not apply to nuclear safety deficiencies resulting from procedural error except when a known or suspected hazard to personnel or equipment exists. . . .
>
> (3) Critical Deficiency--Malfunction of a part, component, installation or system which results or clearly could result, in an unacceptable hazardous situation that requires expenditious corrective action.
>
> (a) For aircraft, any materiel or installation deficiency, regardless of when it is discovered, that could clearly result in an accident/incident or that results in a requirement to use prescribed emergency procedures, or other extraordinary means, to avert damage or personnel injury should be reported by Category I Report. This requirement specifically includes, but is definitely not limited to, failure or significant loss of thrust or power of any engine flight operation.
>
> (b) For missiles, any materiel or installation deficiency requiring identically equipped missiles possessed by the submitting activity to be inspected

for the same deficiency will be submitted as a Category I Report. If the same deficiency is evident in other missiles, certain restrictions must be imposed to lessen the degree of risk involved.

(c) For equipment other than aircraft or missile, materiel or installation deficiencies which require that the affected equipment be withheld from use will be reported as a Category I Report. A critical deficiency on CEM equipment is any malfunction, design deficiency, or equipment (including safety devices) which could result in exposure of maintenance and operating personnel to lethal voltages, excessive radiation, or other potential danger by either direct or indirect action.

(4) Explosive Safety Deficiency--A deficiency or condition presenting a known or suspected hazard to personnel and equipment through malfunction, inadvertent functioning and detonation of ammunition or explosive during use, handling, or storage [32:1-1—1-2].

The Category II Report is a report of:

(1) QUALITY deficiencies in materiel which are attributable to nonconformance to applicable specifications, drawings, standards, technical orders, errors in workmanship, failure to provide or account for all specific parts or other conditions that can be traced to nonconformance during manufacture, repair, modification, or maintenance.

(2) Category II deficiency reports may be permitted for work unit coded (WUC) items on new weapon systems/equipment for which insufficient Maintenance Data Collection (MDC) System historical data exists, and for specifically identified troublesome equipment which has a serious adverse impact on mission capability. Reporting on these items will be agreed upon between the MAJOR COMMAND and ALC involved prior to implementation.

(3) Non-work unit coded (WUC) items (i.e., items which would be listed as "not otherwise coded" in the -06 manual or items not listed in a -06 manual) with design and maintenance materiel deficiencies which do not have a safety impact, but the uncorrected existence of which would through prolonged usage:

(a) Constitute a hazard.

(b) Have a negative effect on operational efficiency.

(c) Reduce tactical of tactical support ability.

(d) Reduce operational life of general service utilization of equipment.

(e) Create economic burdens (manpower and money). Category II reportable conditions embody degrees of risk or requirements calculated to be tolerable within broad time limits [32:1-2—1-3].

Definition of Failure Causes

Cause of Failure	Definition
Damaged in Shipping or Handling	Investigation revealed that the deficiency occurred as a result of damage incurred during shipping or handling of the part between the manufacturer and the user.
DESC Shipped Wrong Part	DESC shipped wrong part to using organization
Defect Attributed to Manufacturer	Investigation confirmed that the defect was the direct result of manufacturer actions other than nonconformance to specifications and drawings.
Defect Caused by Fault in Related Circuit or System	Cause of failure attributed to failure of related circuitry which caused operating limits of the part to be exceeded.
Defect Considered Random in Nature	First time occurrence of a latent defect. DESC had no historical records indicating previous failures.
Defect Direct Result of Maintenance Action	Maintenance activities caused part failure due to noncompliance with technical data or use of improper maintenance procedures.
Defect Verified but Contract No Longer In Existence	Investigation confirmed that defect was the fault of the manufacturer but the contract was no longer valid and no action could be taken.
Failure Attributed to Excessive Shelf Time	Defect occurred when part was placed in service after a long period of storage. The failure was attributed to excess shelf time between manufacture and use.

Definition of Failure Causes--Continued

Cause of Failure	Definition
Inappropriate Substitution of Parts	Parts listed as suitable substitute failed in use. Investigation showed that parts were substituted incorrectly.
Latent Defect	Defect is caused by the development in time, of a change in the device. The precise cause of this change is not always determinable nor is it predictable (26).
Manufacturer Did Not Conform to Specification or Procurement Drawing	The manufactured part did not conform to specifications or procurement drawings as specified in procurement contract.
Materiel Deficiency Exhibit Not Available for Investigation	The materiel deficiency exhibit was not available for use in determining the cause of the defect. Either the exhibt was not held by the user as required, was lost in shipping, or the 30 day holding period required by TO 00-35D-54 had been exceeded and the exhibit disposed of.
No Quality Defect Found During Investigation	Investigation of the deficiency did not confirm that a quality defect existed.
Normal End-of-Life Failure	Part had exceeded reliability estimates of expected life.
Operating Limit of Part Exceeded	Operating limit of part was exceeded because of incorrect equipment modification or for an unknown cause.
Other	Unable to determine cause of failure because of inadequate information on QDR resolution.

Definition of Failure Causes--Continued

Cause of Failure	Definition
Part Failed But No Longer Stocked in Inventory	Actual part failure but part no longer used.
Procurement Drawing Did Not Adequately Describe Part	Procuring activity provided wrong or incorrect drawing to manufacturer.
QDR Not Properly Submitted	Data required by TO 00-35D-54 to complete the investigation was not submitted by QDR originating point.
Supply Issued a Previously Failed Part	Base supply issued a part that had previously been turned in as defective.
Technical Order Not Correct	Technical Order listed the wrong part number or adjustment procedure was incorrect.
Misrouted QDR	QDR erroneously sent to LOIET. The QDR was then sent by LOIET to the correct screening point.
Misapplication of Part (Design)	Specifications of the part were not adequate for the equipment application in which it was used, or design of part did not adequately consider environmental factors that resulted in early failure.

APPENDIX D

SAMPLE CATEGORY II REPORT AND DESC INVESTIGATIVE REPORT

QUALITY DEFICIENCY REPORT
(Category II)

SECTION I

1a. From (Originating point)	2a. To (Screening point)
1b. Typed Name, Duty Phone and Signature	2b. Typed Name, Duty Phone and Signature

3. Report Control No.	4. Date Deficiency Discovered	5. National Stock No. (NSN)	6. Nomenclature
7. Manufacturer/Mfg. Code/Shipper	8. Mfg. Part No.	9. Serial/Lot/Batch No.	10. Contract/PO/Document No.

11. Item ☐ New ☐ Repaired/Overhauled	12. Date Manufactured/ Repaired/Overhauled	13. Operating Time at Failure	14. Government Furnished Material ☐ Yes ☐ No

15. Quantity	a. Received	b. Inspected	c. Deficient	d. In Stock

16. Deficient Item Works On/With					
	a. End Item (Aircraft, tank, ship, howitzer, etc.)	(1) Type/Model/Series			(2) Serial No.
	b. Next Higher Assembly	(1) National Stock No. (NSN)	(2) Nomenclature	(3) Part No.	(4) Serial No./Lot No.

17. Dollar Value	18. Est. Correction Cost	19. Item Under Warranty ☐ Yes ☐ No ☐ Unknown	20. Work Unit Code/EIC (Navy and Air Force only)

21. Action/Disposition

☐ Holding Exhibit for ____ days ☐ Released for Investigation ☐ Returned to Stock/ Disposed of ☐ Repaired ☐ Other (Explain in Item 22)

22. Details (Describe, to best ability, what is wrong, how and why, circumstances prior to difficulty, description of difficulty, cause, action taken including disposition, recommendations. Identify with related item number. Include and list supporting documents. Continue on separate sheet if necessary.)

SECTION II

23a. To (Action Point)	24a. To (Support Point) (Use Items 25 and 26 if more than one)
23b. Typed Name, Duty Phone and Signature	24b. Typed Name, Duty Phone and Signature
25a. To (Support Point)	26a. To (Support Point)
25b. Typed Name, Duty Phone and Signature	26b. Typed Name, Duty Phone and Signature

Carbon paper is required — only face of form is chemical treated

SECTION III

27a. From (Action point)	28a. To (Screening point)
27b. Typed Name, Duty Phone and Signature	28b. Typed Name, Duty Phone and Signature

29. Specification No.	30. Originators Method of Notification

☐ SF 363 ☐ Msg (Copy attached) ☐ Phone Call/Visit

31. Type of Shipment/Purchase

Direct Delivery From Vendor:

☐ Depot ☐ Stock Item ☐ Nonstock Item ☐ Federal Supply Schedule ☐ Other (Specify)

32. Findings and Recommendations of Investigation (Explain in detail. Continue on a separate sheet of paper, if necessary.)

33. Action Taken

34. Results of Depot Surveillance

35. From (Screening point)	36. To (Originator)

37. Distribution

STANDARD FORM 368 BACK
April 1974

DEFENSE SUPPLY AGENCY
DEFENSE ELECTRONICS SUPPLY CENTER
DAYTON OH 45444

TO DESC-LQV

SUBJECT: FSN

TO:

1. Rererence:

2. Results of evaluation:

( ) Discrepancy is/is not verified.

( ) A record of your report will be retained in the DESC computer for 30 months. Action will be taken if a failure pattern develops.

( ) FSN has been made nonpreferred to FSN . Recommend the preferred FSN be ordered.

( ) In order to evaluate the referenced complaint, additional information is required (manufacturer, contract number, part number, details of failure, etc.).

( ) Investigation reveals your application has requirements not specified or controlled by the governing specification. Recommend the problem be referred to the applicable Service Engineering Activity.

( ) Material should be reidentified to FSN Action has been taken to reidentify DESC stock.

( ) Action has been taken to remove incorrect items from DESC stock. Recommend screening of Service stocks.

( ) Your report has been forwarded to DCAS for action necessary to prevent recurrence.

( ) Return defective items to Commander, Defense Electronics Supply Center, ATTN: DESC-LQV, Dayton, OH 45444, marked "UR EXHIBIT, DO NOT PLACE IN STOCK."

( ) Return material to Commander, Defense Electronics Supply Center, Dayton, OH 45444, marked "FOR STOCK," Transportation Funds: 97X4961.5109 01 OC 22.2 S33184.

( ) Material should be administratively disposed of locally.

( ) Material should be retained by your activity for future use.

( ) If Billing Adjustment is desired, you must submit an FAE card with the applicable Billing Adjustment Code (see below) in card columns 59-60-61 with a copy of this letter to Commander, Defense Electronics Supply Center, ATTN: DESC-CAGA, Dayton, OH 45444. If your request meets the criteria for granting credit, adjustment will appear on a subsequent bill.

016 Unacceptable Substitute
021 Short Items
022 Erroneous Material Received
024 Latent Defect
026 Damaged Items

( ) Replacement items should be rerequisitioned. Requisitions already processed cannot be reinstated.

( ) Subject FSN is not a DESC managed item. Your correspondence has been forwarded to:

( ) Remarks:

3. If further assistance is required, request you contact , this Center, AUTOVON 850-56 .

FOR THE COMMANDER:

SAM J. NETHERLAND
Chief, Procurement
Support Branch

Reviewed

APPENDIX E

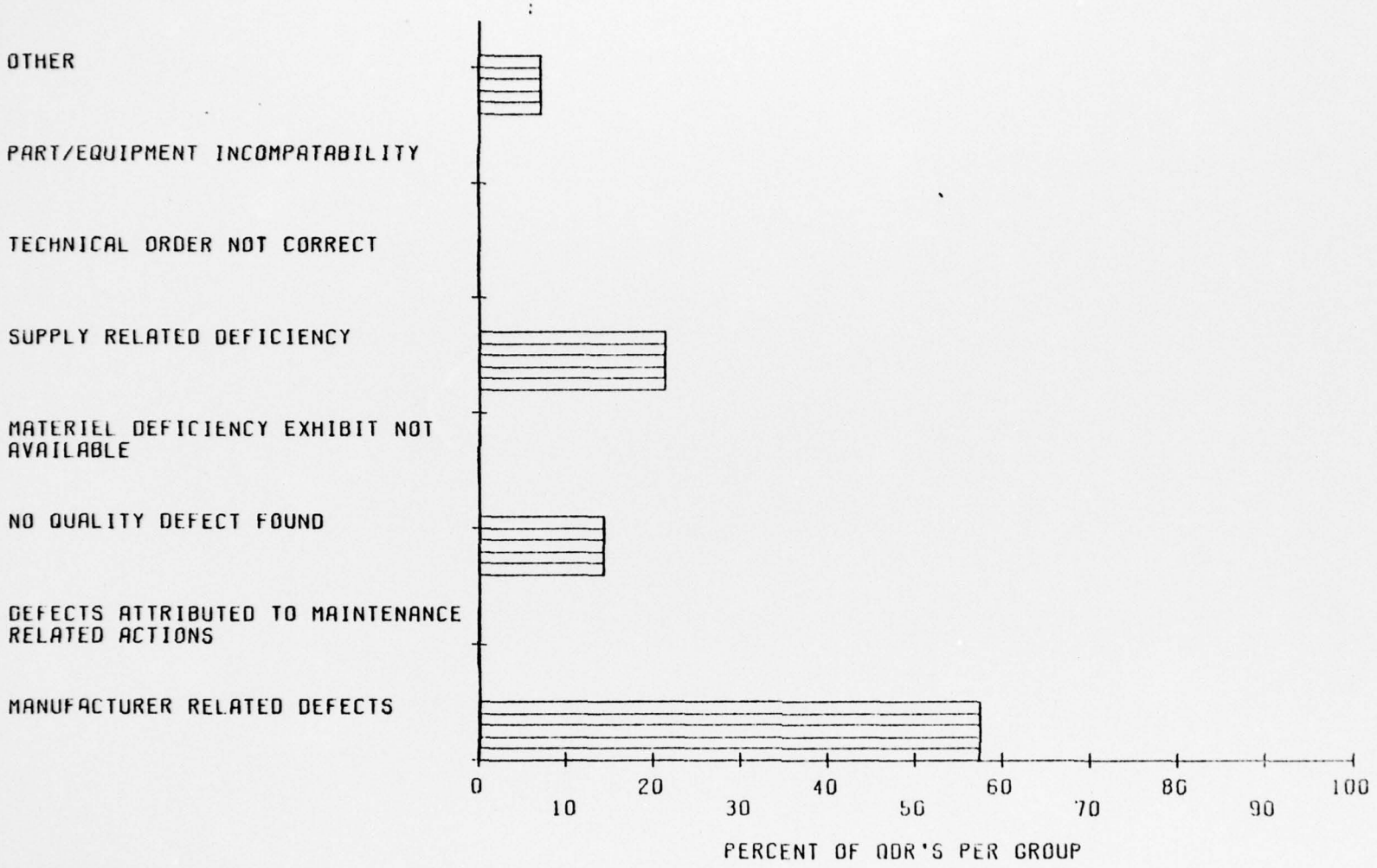
QDRs IN FEDERAL STOCK CLASSES

APPENDIX E

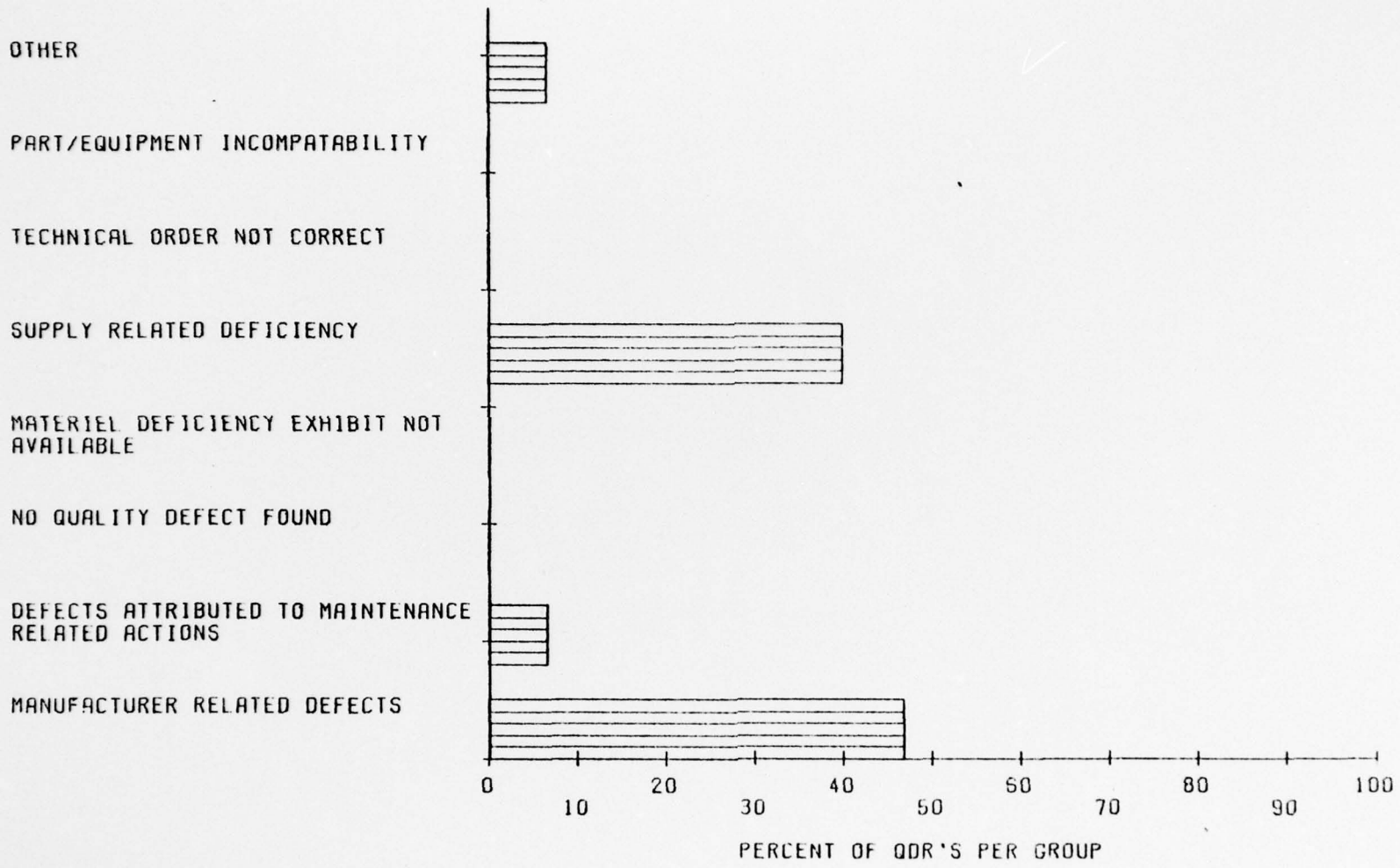
QDRs IN FEDERAL STOCK CLASSES

This appendix contains the following:

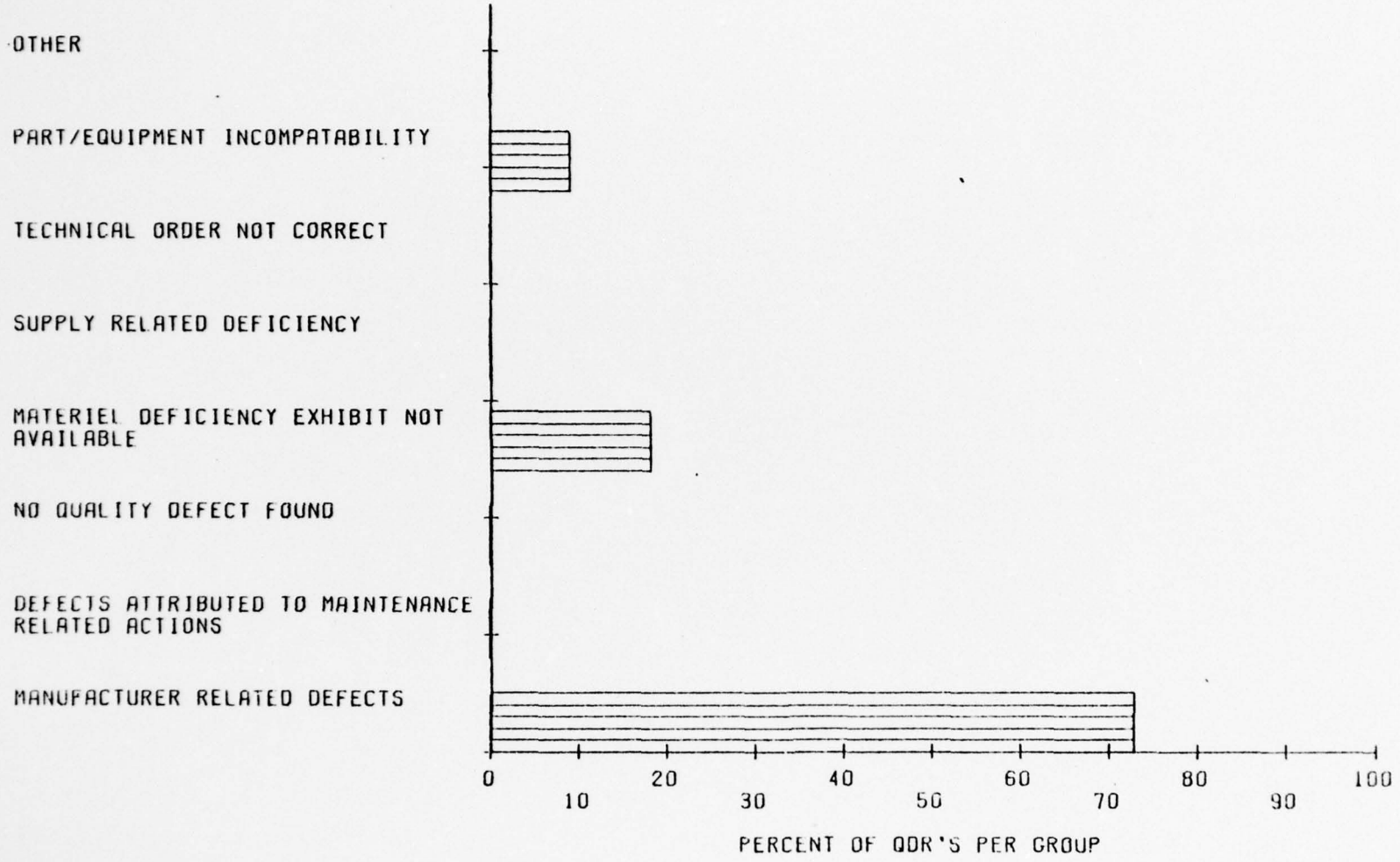
1. Percent of QDRs from FSC 5905 in each group
2. Percent of QDRs from FSC 5910 in each group
3. Percent of QDRs from FSC 5915 in each group
4. Percent of QDRs from FSC 5935 in each group
5. Percent of QDRs from FSC 5950 in each group
6. Percent of QDRs from FSC 5995 in each group.



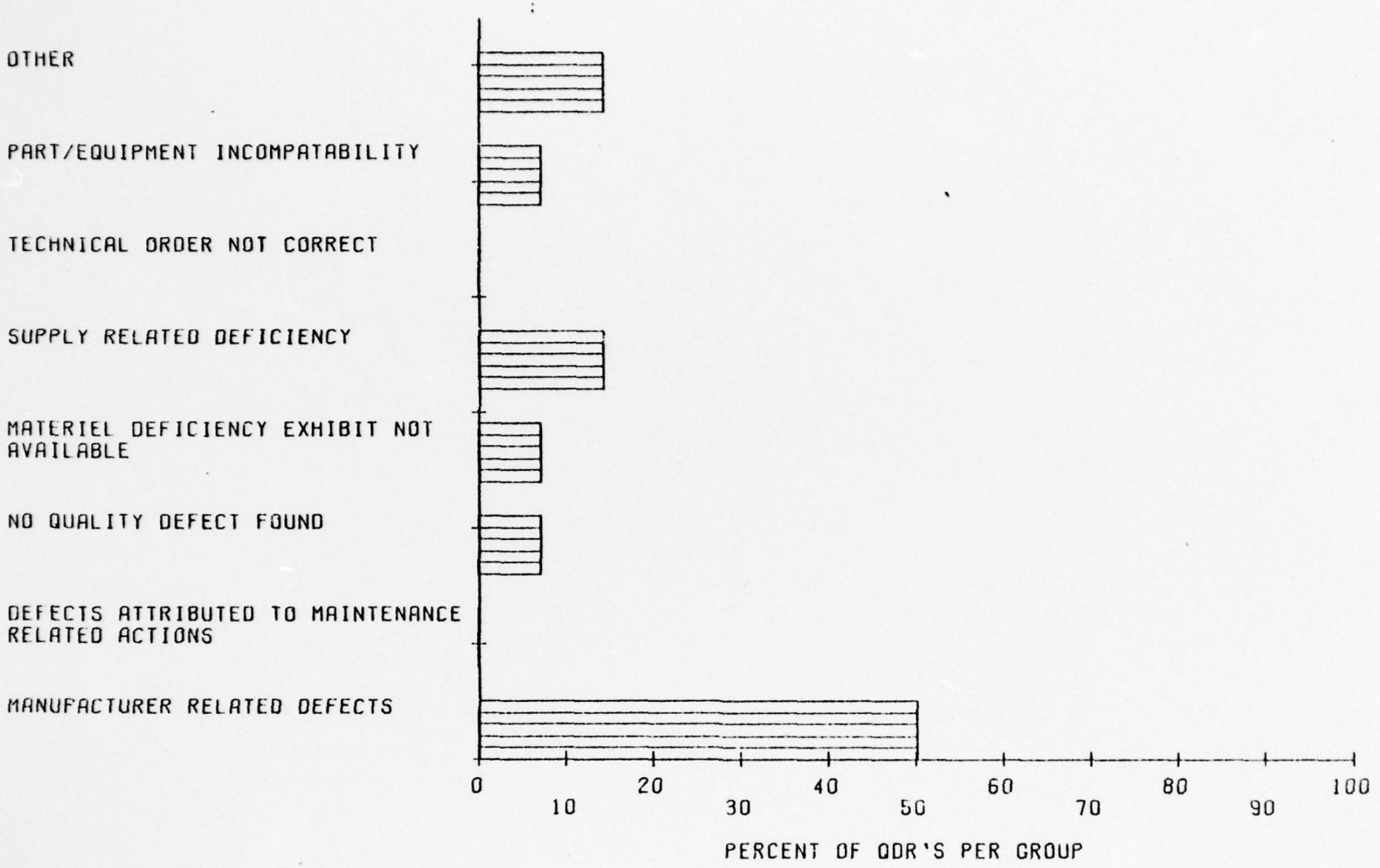
Percent of QDRs from FSC 5905 in Each Group



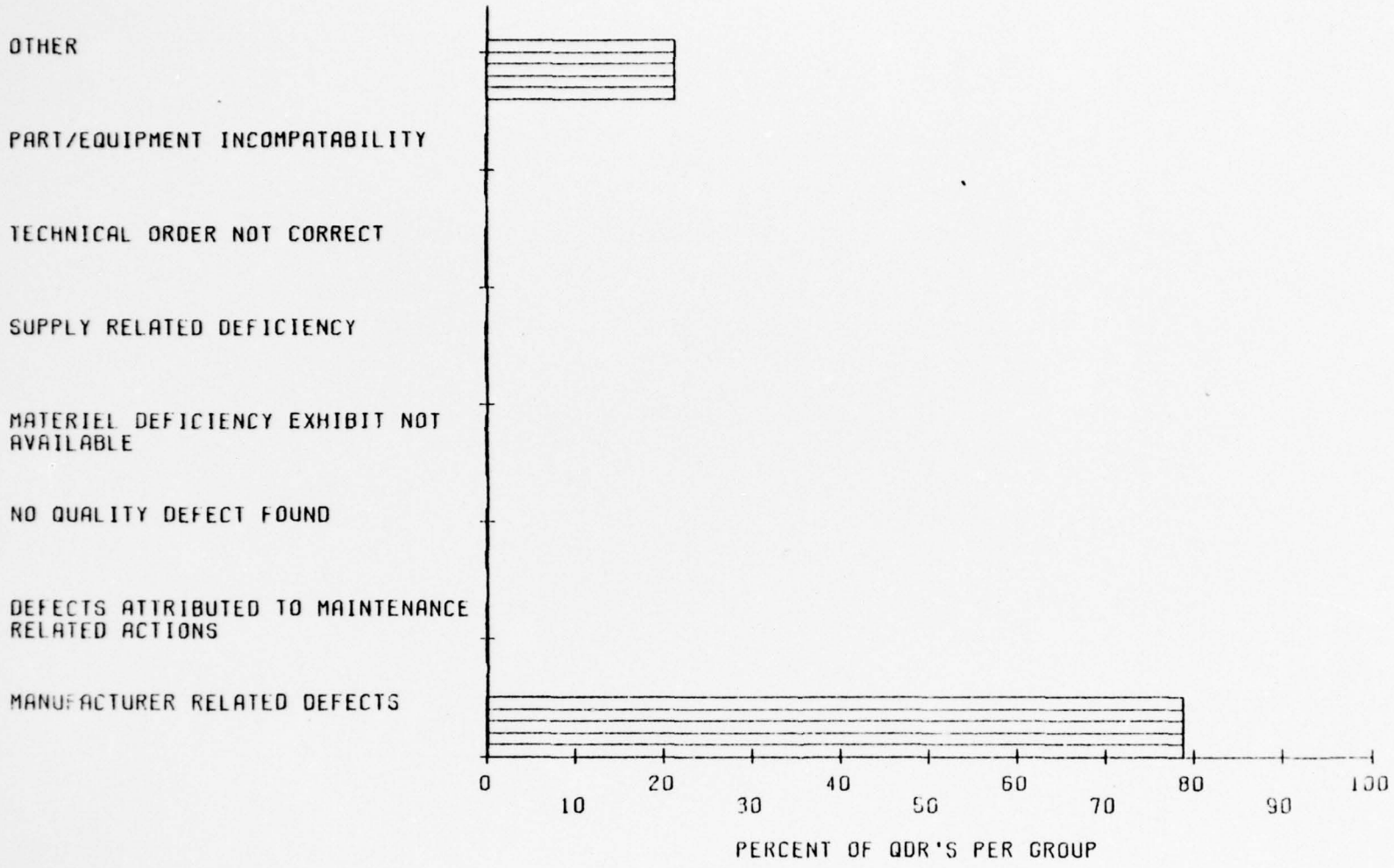
Percent of QDRs from FSC 5910 in Each Group



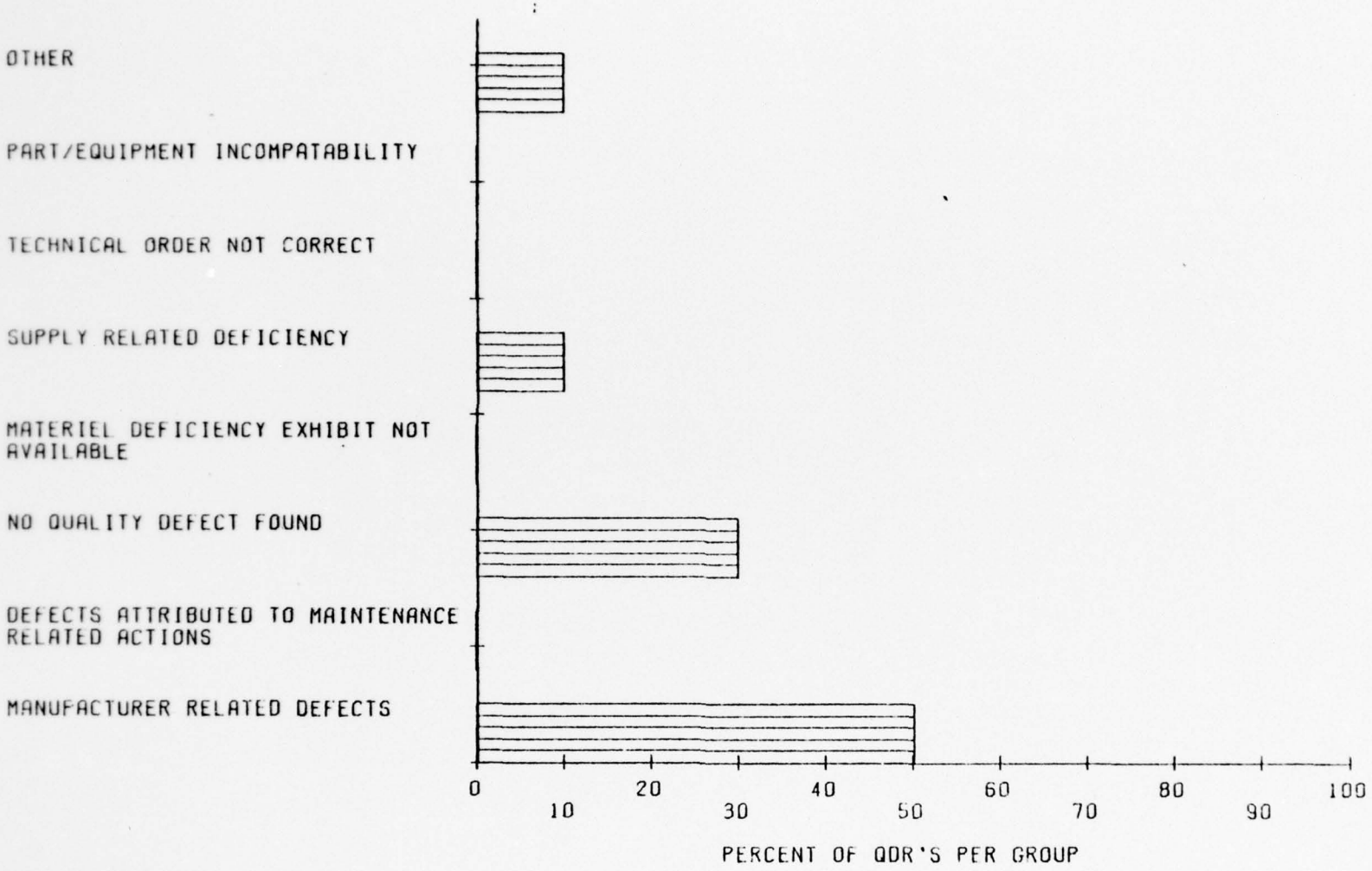
Percent of QDRs from FSC 5915 in Each Group



Percent of QDRs from FSC 5935 in Each Group



Percent of QDRs from FSC 5950 in Each Group



Percent of QDRs from FSC 5995 in Each Group

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